# Electrical Review

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIII. No. 1. NEW YORK, SATURDAY, JULY 4, 1903. ISSUED WEEKLY

ELECTRICAL REVIEW

13 to 21 Park Row NEW YORK

BY THE

ELECTRICAL REVIEW PUBLISHING COMPANY

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REGISTERED CABLE ADDRESS — "Electview," New York.

SUBSCRIPTIONS

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| One Year, United States and Canada | $3.00 |
| One Year, Foreign Countries | 5.00 |
| Single Copies, each | 10 |
| Copies supplied for only one year back, each | 25 |


## A LONG-DISTANCE SUBMARINE TELEPHONE CABLE.

The Anglo-Belgian telephone cable was opened for service on June 8. This cable forms the submarine portion of the London-Brussels telephone line, the entire length of which is 245 miles. The cable forms 54.2 miles of this, and is the longest submarine telephone cable which has yet been laid. The cable consists of four stranded conductors, each insulated with gutta-percha armored with brass sheathing and steel wire.

*An Unloaded Cable.*

Although this cable is comparatively short, compared with submarine telegraph cables and overhead telephone circuits, it nevertheless marks a noteworthy advance in submarine telephony. No attempts were made to improve the quality of this cable by the use of inductances distributed along it, although the latter construction would have furnished a much better talking circuit. Tests of the latter construction have been made both in this country and abroad, which have clearly demonstrated the value of this system, and although the difficulties of constructing and laying this type of cable are not slight, they will undoubtedly be overcome as soon as the demand for submarine telephony makes this necessary.

## AN INTERESTING APPLICATION OF THE STEAM TURBINE.

The steam turbine, as a prime mover, has received a good deal of attention of late, and its advantages have been thoroughly discussed. One of these advantages is the ability to use the expansive force of steam down to a very low absolute pressure. The reciprocating engine is limited in this respect by the enormous increase in volume of steam as the pressure decreases, and for this reason this type of engine is not able to take full advantage of a high vacuum. The low-pressure cylinder would be much too large, and friction and other losses correspondingly increased. In the turbine, however, the steam can be used to advantage with the highest degree of vacuum, and this property of the turbine was taken advantage of recently in an interesting installation.

*The Accumulator System.*

The system is described in a current issue of the *Engineering,* and was worked out by Professor A. Rateau, of the French Department of Mines, and has been installed in the Bruay mines, France. The problem here was to secure a more economical operation of the mining plant, but the solution is applicable to other industries where the conditions do not allow a reciprocating engine to work efficiently, and it seems inadvisable to install an entirely new plant. The plan used is to exhaust steam from the engines into a steam accumulator, where the heat is stored up and is utilized to furnish low-pressure steam as needed to steam turbines which exhaust into a condenser operating with a high vacuum.

*Steam Accumulator.*

The accumulator consists of a large iron cylinder, in which are placed, one above the other, a number of shallow cast-iron trays, circular in form and separated by narrow spaces for the passage of steam. The trays are kept nearly full of water and offer a large surface for the condensation of steam and for its rapid re-evaporation. This accumulator has as large a mass of metal and of water as possible.

*Available Power.*

In this particular case it was estimated that the mine engine, which was rated at 175 horse-power, was consuming about 100 pounds of steam per horse-power-hour, this poor showing being caused by the character of the work. It was estimated that a turbine drawing its steam from the accumulator at about atmospheric pressure and exhausting into a condenser with a pressure of about 2.13 pounds absolute, would consume about thirty-five pounds of steam per electrical horse-power. Allowing a loss of twenty per cent in the piping, it would seem that the exhaust steam from the 175-horse-power engine could be used to generate 400 electrical horse-power.

*Application to Rolling Mill.*

Professor Rateau also considers the case of a large rolling mill where it is not unusual to find a plant consuming 150,000 pounds of steam per horse-power-hour. The use of exhaust steam turbines in this case, it is estimated, would make available about 3,000 electrical horse-power.

In considering the advantages of this plan, the following points can be named. No additional boiler capacity is required, but against this should be set the cost of the steam accumulator, though these are much less expensive. The old plant is retained and no additional labor is necessitated at the boiler house. At the Bruay mines, a horizontal turbine unit has been installed, driving two continuous-current dynamos keyed to the steam shaft at from 1,500 to 1,800 revolutions per minute. These machines are each able to supply 450 amperes and 250 volts. Under test, this unit has shown a performance of 39.67 pounds of steam per electrical horse-

power-hour, although the vacuum was only twenty-seven and one-half inches. The installation is most interesting as showing how the ability to pass large volumes of steam through the turbine may be taken advantage of.

## TRANSFORMERS.

Electrical transformers are of various kinds and for various purposes. We have transformers for transforming from one potential to another, for transforming constant potential to constant current, for transforming an alternating current to direct current, or *vice versa*, and for transforming from an alternating current of one frequency to that of another.

The word "transformer" by common consent has been limited to that type of apparatus which transforms an alternating current from one potential to that of another. Where more definiteness seems desirable, it is customary to designate this type of apparatus as a static transformer, but there is very little chance for confusion in any case, as transformers intended for other purposes are always designated by some distinguishing term, such as rotary transformers or frequency transformers.

The static transformers may be further subdivided into the so-called constant-potential and constant-current types. The constant-potential transformer is one of the simplest electrical mechanisms, but the theory of its operation is somewhat complex. It depends for its action upon the laws of magnetic induction discovered by Henry and Faraday. It consists of an iron core upon which are wound two or more coils. In the type generally used in this country the iron core is in the form of a single or double ring. The action may be described in this way:

### *Action of the Transformer.*

An alternating current is passed through one of these coils. This sets up in the iron which it surrounds a magnetic field, which, of course, varies with the current. Now, one of the most general laws of physics is that enunciated by Lentz, as a direct consequence of the law of the conservation of energy. This states that whenever any physical force produces an action, a reaction is set up which opposes the original force. Applying this law to the transformer, we apply an alternating electromotive force to the terminals of one of the coils. This sends through the coil an alternating current. The alternating current sets up an alternating magnetic field, and the alternating magnetic field sets up in the coil an alternating electromotive force which opposes the applied electromotive force. The result, of course, is to allow to pass only sufficient current to set up such a magnetic field as will induce this counter-electromotive force. Now, this alternating field sets up an electromotive force not only in the magnetizing or primary coil, but as well in any other coil wound on the same core. Since the electromotive force developed in either case depends only upon the strength of the magnetic field, the number of reverses per second and the number of turns of wires, the electromotive force of the secondary coil can be made anything desired by selecting a proper ratio of the number of turns in the two coils.

### *Reaction of the Secondary Current.*

The electromotive force developed in the secondary coil may be used to supply current for any desired purpose, but when current is drawn from this coil the energy must, of course, be supplied by the primary coil, which naturally means that a greater primary current must flow. To explain this we again make use of Lentz's law. When a current is drawn from the secondary coil this tends to set up a magnetic field in opposition to that field which induces the secondary electromotive force. The result would be a weakened magnetic field in the core. This weakened field would not only lower the electromotive force induced in the secondary, but, as well, lower the counter-electromotive force in the primary, and an increased current would flow through the primary coil, bringing the magnetization back to its original value. The reaction of the secondary current is balanced by the increase in the primary current. The reactions then balance themselves in such a way that the power drawn from the secondary circuit is equal to that supplied to the primary, less the losses in the iron and copper of the transformers; and it is found that in a well-designed transformer the magnetization of the iron is practically constant, so that, given a constant applied electromotive force at the primary, a constant electromotive force is developed in the secondary. That a constant electromotive force is not delivered by the secondary is caused by the loss of potential, due to the resistance of the primary and secondary coils.

### *Leakage.*

Another reaction appears, though to a slight degree in well-designed transformers. This is the magnetic leakage. Since the currents in the primary and secondary coils tend to set up opposing magnetic fields, a stray field may leak around through one coil without passing through the other.

### *Constant-Current Transformers.*

This reaction has, however, been made use of in the so-called constant-current transformers. One of the early types of constant-current transformers provided a leakage or by-path for the magnetic lines, so that an increase of the current in the secondary coil forced more lines across this path and tended to lower the secondary electromotive force, and thus prevent a large increase of secondary current.

### *Later Type of Constant-Current Transformers.*

The more recent types of constant-current transformers regulate in the same method by furnishing a leakage path, but accomplish this in a little different way. The primary coils and secondary coils of the transformers are mounted so that they may be moved together or apart. The iron circuit is long, allowing for this motion. The coils are then carefully suspended on rocker-arms, so that they tend to come together. Applying a constant potential to the primary coil, an electromotive force is set up in the secondary. As soon as any current is drawn from the secondary coil the repulsive action between the two currents flowing in the two coils forces them apart, and thus offers a path for leakage of the magnetic field between the two coils. The greater the current, of course the greater the repulsive force and the greater the distance between the coils. Transformers of this type are capable of very close regulation.

## METHODS OF COMBINING RESISTANCES—III.

BY EDWIN F. NORTHRUP.

### PLUGGING IN OR DECADE METHODS.

Rheostats are commonly constructed to be operated on the decade plan, with either plug contacts or dial switches. In the ordinary plug decade arrangements there are either 9 or 10 one-ohm coils for the units place, 9 or 10 ten-ohm coils for the tens place, 9 or 10 one-hundred-ohm coils for the hundreds place, and so on. Each set of coils having the same value is designated a decade. In case there are a number of decades in a rheostat, it is not usually necessary to employ more than nine coils for each decade, except the decade of lowest denomination, where it is often advisable to use ten coils. By using ten coils in the decade of lowest denomination, the total resistance value of the rheostat is raised to an even 100, 1,000 or 10,000, according to the number of decades used. The extra coil enables the rheostat also to be more conveniently checked up by intercomparison of the different decades. Connections for an ordinary decade arrangement, as usually constructed, is shown in Fig. 17.

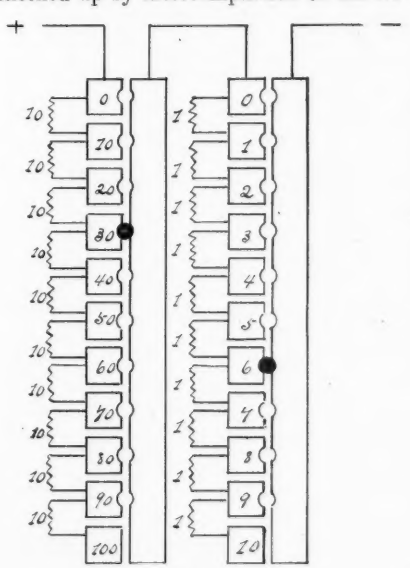


FIG. 17

By reference to the diagram it is evident that any value from 0 to 10 in steps of one ohm (of a decade using unit coils) can be obtained by *inserting* between a bar and a block one, and only one, plug. It also appears, that if several decades are connected in series, any value up to the limit of the set can be read directly from the position of the plugs, without any mental effort whatever.

Besides the advantages of the decade arrangement above mentioned, the following may be added: The single plug used with each decade is never out of use, being either at the zero position or set at some value, and hence is not easily lost by being laid aside. The use of only one plug to the decade makes it easy to ascertain that this plug is tightly fitted in its place and making good contact. As only one block in a row is plugged at a time, the other blocks are not kept under a strain by having plugs tightly forced between them.

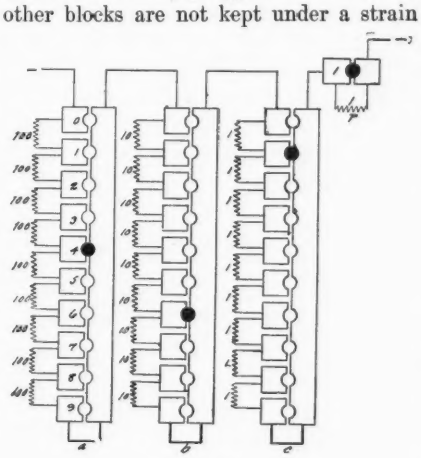


FIG. 18.

This strain of the blocks, which must exist in sets where a coil is put in circuit by removing a plug, tends to separate or loosen them, and often to warp the hard rubber upon which the blocks are mounted and to cause other plugs to loosen when some are pushed in tight. The decade plan alone permits of obtaining a succession of values in a simple manner with dial switches or sliding contacts.

The best way to construct a rheostat on the decade plan with nine coils to the decade is shown in Fig. 18.

Here all the coils of the set are connected in series so the circuit is never open when the plugs are removed. It is an advantage to have the permanent connections shown at *a*, *b* and *c*, for then all the coils of the decade can be thrown in circuit by simply removing a plug, it not being necessary to insert it again as would be the case if the connections *a*, *b* and *c* were not made. Moreover, if any plug makes a bad contact its effect is somewhat lessened by having this bad contact shunted with the remaining coils of the decade. Again there are occasions when violent deflections of a galvanometer are prevented by not having the circuit entirely open when the plug is taken out. The capacity of the arrangement, shown in Fig. 18, is raised to 1,000 by adding the extra one-ohm coil at P.

Any value can be instantly read, as 247, by observing the position of only as many plugs as there are decades. Adding the extra one-ohm coil permits of making the following checks of the resistance. All the ones equal a ten, all the tens plus all the ones equal one hundred, all the hundreds plus all the tens plus all the ones equal one thousand, and so on.

### METHODS FOR ADDING TO THE ADVANTAGES OF THE DECADE. THE ADVANTAGES OF FEW COILS.

The advantages of decade arrangements of coils for rheostats are so numerous that their adoption would long ago have become universal, if it were not for the fact that a larger number of coils are required for a given range of values than are needed in the other methods described. As the chief expense in constructing precision rheostats is connected with the adjustment of the coils, there is a great saving by using only a few coils, as in Siemens plan or the 1 — 2 — 3 — 4 method. The ideal arrangement, especially for precision rheostats, where each of the coils must be adjusted to a high degree of precision, is to be found in a method which will combine the advantages of the decade arrangement with the use of very few coils —no more than are employed in the 1 — 2 — 3 — 4 or 1 — 2 — 2 — 5 or 1 — 1 — 3 — 5 arrangement.

With this ideal arrangement in view, two different methods have been devised; one due to M. Feussner and one to A. O. Beneke. Several other methods have been recently devised by the writer, which will be described after giving an explanation of the two mentioned above.

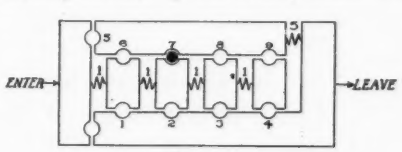



FIG. 19.

### FEUSSNER'S METHOD.

In this method values from 0 to 9, in steps of one ohm, or any even multiples of these numbers, are obtained with four one-ohm and one five-ohm coils or even multiples of these. A reference to Fig. 19 will make the arrangement perfectly clear without further explanation.

Precision rheostats constructed on this plan, and chiefly used in connection with Wheatstone bridges, have been made by European instrument makers.

### BENEKE'S METHOD.

This method is very similar to Feussner's. The plan of arranging the coils is easily understood by reference to Fig. 20.

The method employs six coils, and values 0 to 10, inclusive, are obtained.

The two above methods make a saving of about one-half the coils over the ordi-

nary methods of constructing decade rheostats, and in this respect are superior. The following objections may be urged against these methods: The block construction is rather expensive, the series values are not arranged in straight rows, so that a large number is not quite so directly read from the position of the plugs as in the ordinary decade arrangement, the surface of the rubber between the blocks is not so easily got at to be cleaned, the methods are not adaptable to sliding contacts or dial switch arrangements, and, finally, it is possible to obtain the decade with a still smaller number of coils.

THE WRITER'S METHODS.

In describing these methods a typical arrangement of the coils will first be given, and then a list of other arrangements by which similar results may be obtained.

1, 3, $3^1$ and 2-ohm coils are connected in series, as shown in Fig. 21.

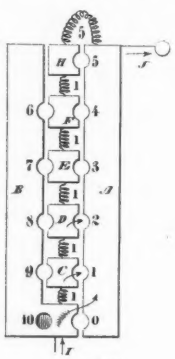


FIG. 20.

Let the terminals of the one-ohm coil and the two-ohm coil and the points of union of the coils be numbered, (1), (2), (3), (4), (5), as indicated in Fig. 21. The current enters at the point (1) and leaves at the point (5), traversing $1 + 3 + 3^1 + 2 = 9$ ohms in all.

This series may be multiplied by any factor $n$, in which case the current traverses $n\ (1 + 3 + 3^1 + 2) = n\ 9$ ohms

If now the points (1) and (5) are connected, all the coils are short-circuited, and the current traverses 0 resistance, if the points (2) and (5) are joined the 3, $3^1$ and 2-ohm coils will be short-circuited and the current traverses one ohm. By extending this process, in which two points and only *two points* are joined, it is possible to obtain the regular succession of values, $n$ (0, 1, 2, 3, 4, 5, 6, 7, 8, 9), the last value being obtained when no points are joined and the current passes through all the coils in series. In the table below are given the points which must be connected in pairs for obtaining each of the above values and the coils which will be in circuit corresponding to each value.

| Value. | Points Connected. | Coils Used. |
|---|---|---|
| 0 = | (5 — 1) | 0 |
| 1 = | (2 — 5) | 1 |
| 2 = | (4 — 1) | 2 |
| 3 = | (2 — 4) | 1, 2 |
| 4 = | (3 — 5) | 1, 3 |
| 5 = | (1 — 3) | $3^1$, 2 |
| 6 = | (2 — 3) | 1, $3^1$, 2 |
| 7 = | (5 — 4) | 1, 3, $3^1$ |
| 8 = | (1 — 2) | 3, $3^1$, 2 |
| 9 = | 0 | 1, 3, $3^1$, 2 |

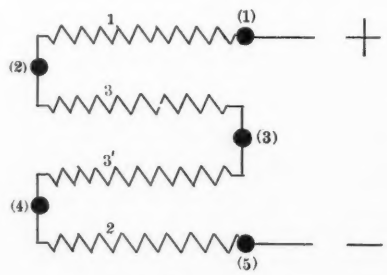



FIG. 21.

Suppose now we make two parallel rows of blocks, ten blocks in each row. Let the blocks be so arranged that opposite blocks can be connected together by the insertion of a plug. To the first pair of blocks let the points (1) and (5) of Fig. 21 be connected, to the second pair of blocks let the points (2) and (5) be joined, to the third pair the points (4) and (1), to the fourth pair the points (2) and (4), to the fifth pair the points (3) and (5), to the sixth pair the points (1) and (3), to the seventh pair the points

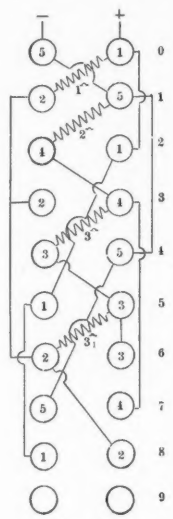


FIG. 22.

(2) and (3), to the eighth pair the points (5) and (4) and to the ninth pair the points (1) and (2). It is now evident that if a plug be inserted between the first pair of blocks 0 resistance will be obtained between the points (1) and (5), if the plug is inserted between the second pair of blocks the resistance will be one ohm. Thus all values from 0 to 9 can be obtained by traveling the plug down the double row of blocks.

Fig. 22 shows the arrangement of these two rows of blocks diagrammatically and the manner in which they would be connected up in actual practice.

The numbers, in the circles representing the blocks, correspond to the points (1) to (5) of Fig. 21. The numbers 0 to 9 to the right of the double row of blocks indicate the resistance values which would be obtained when a plug is inserted between any pair of blocks. Thus, inserting a plug between the blocks 1 — 5 the value is 0 resistance, inserting a plug between the blocks 2 — 5 the current traverses the one-ohm coil, inserting the plug between 4 — 1 the current traverses the

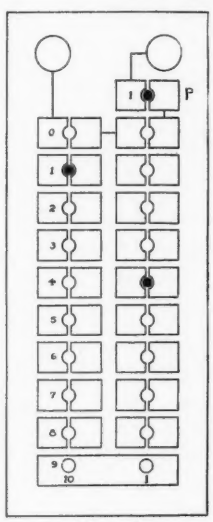



FIG. 23.

two-ohm coil. Again, if the plug is inserted between 5 — 4 it will be seen by carefully tracing the diagram that the current traverses the 1, 3, $3^1$ ohm coils, giving seven ohms.

The value 9 is obtained when the plug is withdrawn or is disposed of by being inserted in the last pair of blocks which have no connections.

Fig. 23 gives a top view of a rheostat of two decades arranged on this plan.

In the decade of lowest denomination an extra one-ohm coil is added at P to make the rheostat read to an even 100.

In a rheostat constructed on this plan any value can be instantly read off by observing the position of as many plugs as there are decades. Further, it is only necessary to stamp one row of figures 0 to 9 on the left-hand row of blocks of the rheostat and to designate at the tops of the rows the different decades as the unit decade, the ten decade, etc.

*(To be continued.)*

# *Electrical Equipment of the New Orleans Drainage System.*

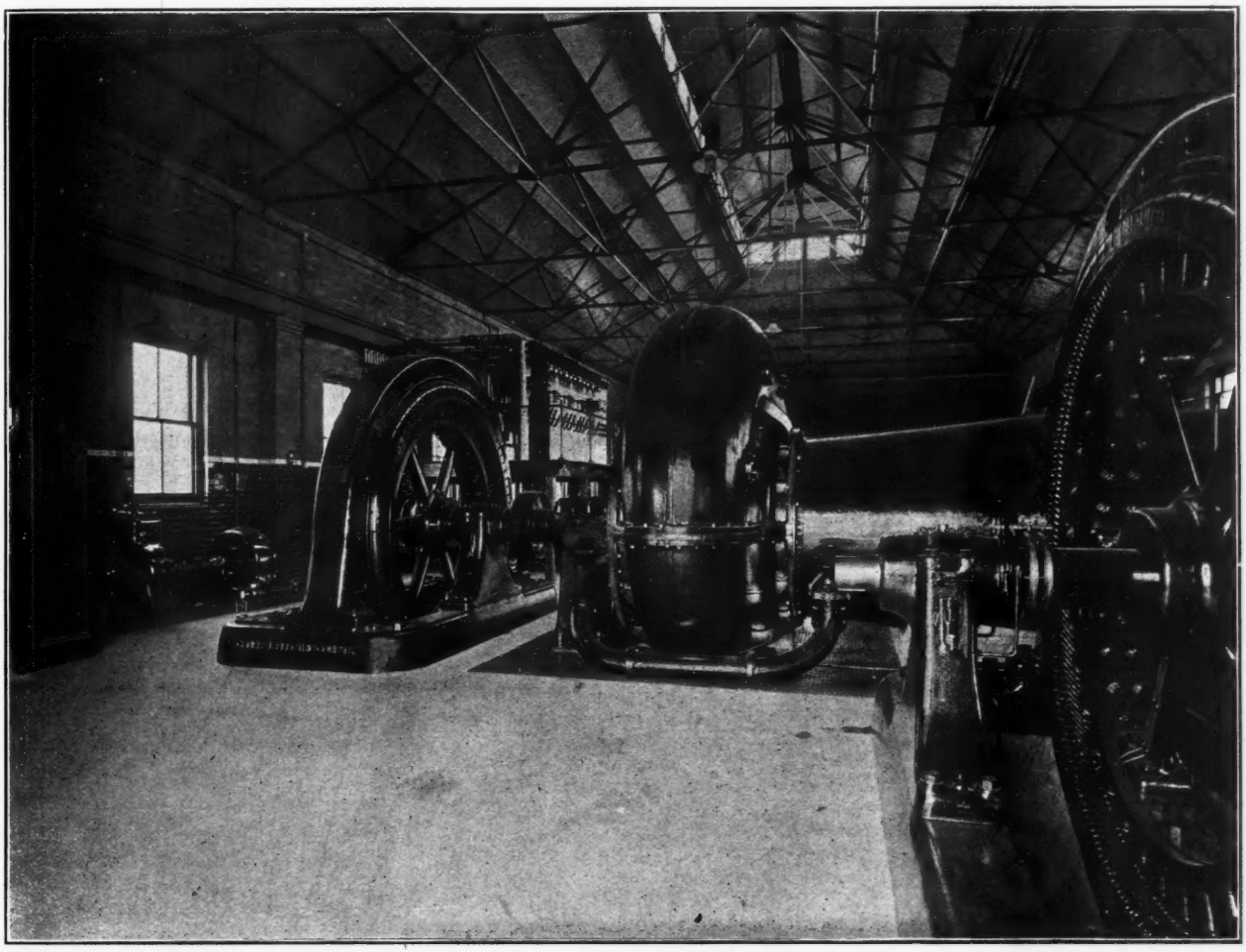
*By William Mayo Venable.*

THE city of New Orleans has just completed that portion of its drainage system which can be constructed with the funds that can be devoted to this purpose derived from the sale of public improvement bonds for water supply, sewerage and drainage. The various pumping stations in this drainage system are driven by electric power, which is supplied from a central power-house, located on the outskirts of the city. From an electrical viewpoint this system is unique. It is a very large equipment of three-phase machinery connected to large centrifugal and screw pumps, and operating under conditions which are entirely different from those which usually govern the operation of an electrical transmission system.

The chief condition which is radically different from those usually to be encountered is the extreme irregularity in time of operation. Power is required only during and after storms, excepting a small amount of power required to pump the constant duty drainage. As a result the larger portion of the plant must be kept in readiness for sudden operation, but is during far the greater portion of the time entirely idle. Under such conditions economy such as can be achieved in central stations carrying a comparatively steady load is out of the question, but a greater economy is effected than would be if the system were operated by steam without the intervention of electricity. This economy comes from the ability to concentrate the steam plant at one central station instead of distributing it at several pumping stations, and from the lesser number of regular employés required to operate a central station and substations equipped with electric motors over what would be required to operate corresponding pumping stations with the same number of engines as there are pumps.

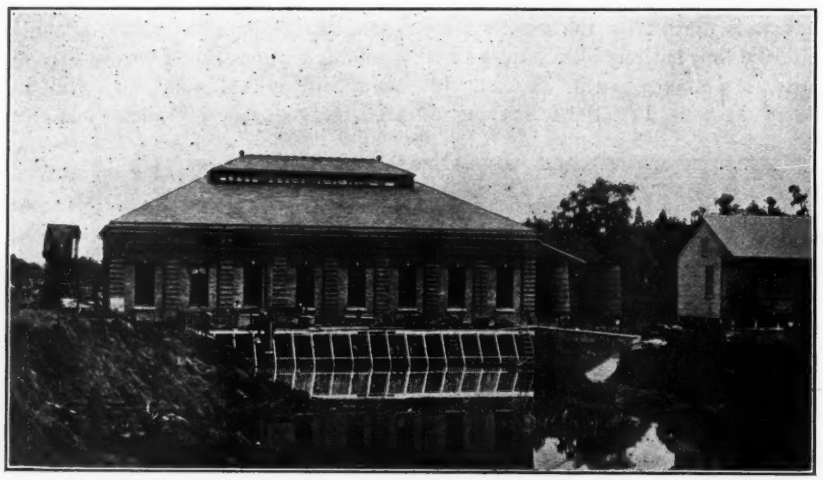
At the present time only about one-half the machinery which it is ultimately intended to install has been put into operation. This is distributed among five pumping stations that have recently been built, with a very small equipment at a sixth station originally operated by steam, but recently equipped with an electrically driven pump. Of these pumping stations only one has a complete equipment at the present time, another station has three-quarters of its complete equipment, another two-fifths, another three-fifths and another two-fifths.

The electrical current used in this equipment is distributed on the three-phase system at twenty-five cycles per second and 3,150 volts. Central station is equipped with a number of three-phase gen-



VIEW SHOWING ONE LARGE PUMP AND TWO LARGE MOTORS IN PUMPING STATION NO. 3. THE SWITCHBOARD IS SHOWN IN THE REAR, AND A CENTRIFUGAL FIRE PUMP, OPERATED BY ELECTRICITY, IS SHOWN BENEATH THE WINDOW AT THE LEFT.

erators to deliver current to the lines and the bus-bars, and switches are so arranged that any generating unit can be used singly to supply current to any set of feeders leaving the station or in connection with any number of other units in multiple upon any combination of feeders. The generators are all of the usual type, mounted on horizontal shafts directconnected to steam engines. The regulation of the generators and engines varies with their size, but no difficulty is encountered in operating the units in multiple.

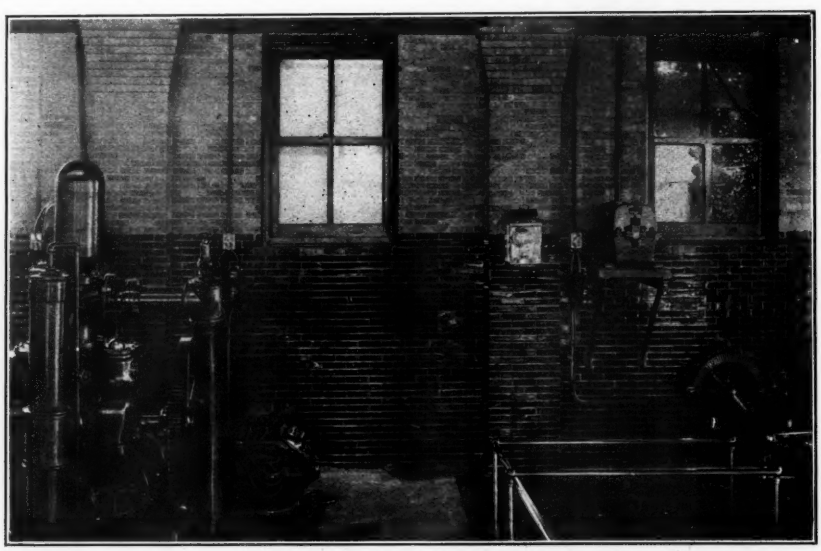


SUCTION SIDE OF PUMPING STATION NO. 6, WHERE THE WATER IN THE CANAL IS ABOUT TWELVE FEET DEEP. WHEN THE PUMPS ARE RUNNING THE WATER IS PUMPED LOWER. THE SCREEN IS TO PREVENT STUMPS FROM REACHING THE PUMPS.

Two sets of feeder lines run to each pumping station, where they may be connected to either of two sets of bus-bars or to both sets. These bus-bars run along the various panels of the switchboard, of which there is one for each motor connected to a drainage pump, and one for each of two rotary converters. These rotary converters are operated by the three-phase current taken from ordinary stationary induction transformers, where it has been reduced to a low voltage. The continuous-current side of the rotary transformers furnishes current at 125 volts, which is used to excite the moving fields of the large motors, to furnish light for the station and to operate various small motors at the station for the purpose of opening and closing gates, operating machine tools for repair work and pumping out the pits in which the large pumps are located whenever it is necessary to get at portions of these pumps, which are ordinarily under water.

Current from the line passes through fuse blocks and lightning arresters before reaching the bus-bars. The bus-bars are connected with any motor or the transformers by means of oil switches, and no connection is neccessary to start up any unit, but to throw in one set of these switches upon a set of bus-bars it is absolutely impossible to make any mistake or to do any harm in operating the board.

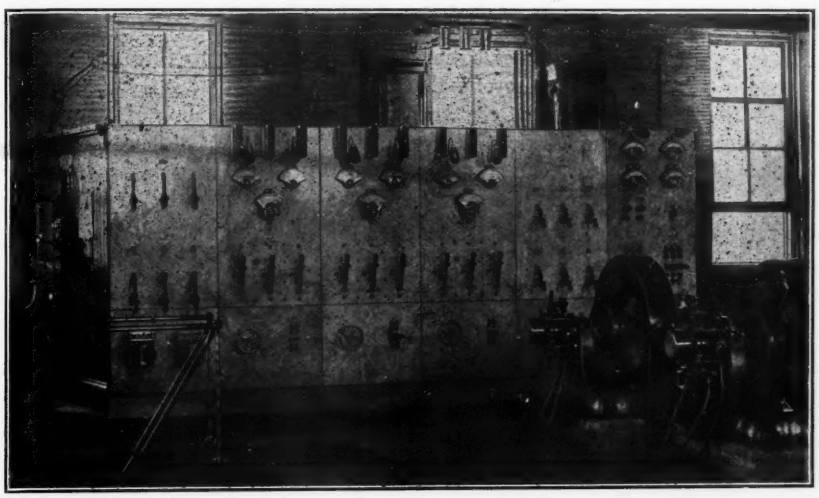
The motors at all of the stations are of the three-phase synchronous type and are direct-connected to the shafts which carry the moving parts of the centrifugal or screw pumps. In one of the stations these shafts are on a horizontal plane, and the pumps are above the floor line. At the other stations the shafts are vertical, the motors being above the floor line and the pumps in the bottom of pits especially constructed to receive them. This latter method has the advantage of higher efficiency, owing to the shorter water courses. It has also the advantage of not requiring any priming in order to put the pump in operation. On the other hand, it has the disadvantage of having the pump located below water level and consequently not so readily accessible for repairs, and the disadvantage of requiring gates on both the suction side and the discharge side of the station in order to keep the water out of the pumps and the pits when repairs are being made, and to keep the water from flowing back through the station when the pumps are idle. The most interesting feature of this equipment is the method of starting, the motors being synchronous they can not be started under a heavy load with the engines running at full speed. It is impossible to get them up to speed with no load unless the pits are pumped out. The method that is actually employed is to start pumps and engines together and bring them up to speed together. This has been found a very economical and satisfactory method. It is possible to start several pumps at the same time by this method, or to use one engine for picking up pumps successively and transferring each pump to the main bus-bars upon which many generators are operating in multiple as soon as the individual pump is brought up to speed. To shut down any pump all that is necessary is to open the main switch and close the gates. One station is provided with flap valves on its discharge side and other stations are soon to be provided with similar valves, so that it will be necessary only to open the switch in order to shut down any motor.



PUMP USED FOR PUMPING OUT THE PITS IN WHICH THE LARGE DRAINAGE PUMPS ARE PLACED WHEN IT IS NECESSARY TO DESCEND INTO THE PITS TO MAKE REPAIRS. THE MOTOR WHICH OPERATES THE GATE AT THE DISCHARGE SIDE OF THE STATION IS ALSO SHOWN ON A LEVEL WITH THE BASE OF THE WINDOW. A HORIZONTAL ROD RUNS THROUGH THE WALL FROM THE MOTOR TO THE GEAR PIT.

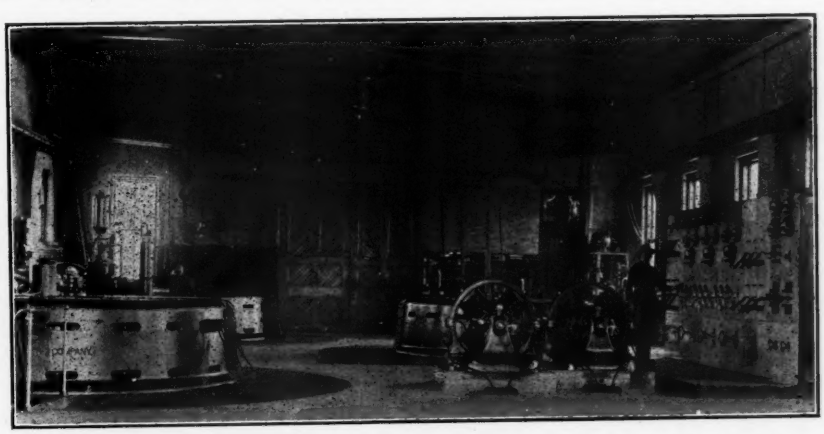
A discharge of 250 cubic feet of water per second at normal head has been taken

as the standard size for pumping units. The height to which this water is lifted at different stations varies. At pumping stations Nos. 6 and 7, which are equipped with submerged centrifugal pumps, this height is ten feet with a possibility of an increase to twelve or thirteen feet by speeding up the generators. Of course,



THE SWITCHBOARD AND ROTARY CONVERTERS AT PUMPING STATION NO. 7. ONE OF THE TRANSFORMERS WHICH LOWERS THE POTENTIAL FOR USE IN THE ROTARIES IS SEEN PROJECTING ABOVE THE TOP OF THE SWITCHBOARD.

at heads less than ten feet the pumps discharge very much more water, having a maximum discharge capacity of about 350 or 400 cubic feet at the lowest heads that are ever encountered. Pumping station No. 3 pumps against a head of eight feet under normal conditions. It has two pumps above the floor line, discharging at this head, and one constant duty pump which at present is capable of discharging at a head of sixteen feet, a total amount of seventy cubic feet per second. Pumping stations Nos. 1 and 2 are equipped with screw pumps of 250 cubic feet capacity each, operating against a



THE GENERAL ARRANGEMENT OF THE INTERIOR OF PUMPING STATION NO. 6.

head of five feet. There are three of these pumps at station No. 1 and two at station No. 2 at the present time, besides constant duty pumps of the centrifugal type of forty cubic feet capacity each and a lift of ten feet. The sizes of the motors required to operate these various units are as follows:

Each unit at stations Nos. 6 and 7.375 kilowatts.
" " " 3..... 300 "
" " " 2.....220 "

The pumping stations are scattered in various parts of the city at from one mile to five miles distance from the central power-house. Communication is established between all of the stations by a private telephone system carried upon the same poles as the power transmission lines, but there is also a separate communication between several of the pumping stations and the local telephone exchange.

## *Regulations for Electric Cars and Automobiles in Leipsic, Germany.*

Consul B. H. Warner writes from Leipsic, Germany, the following communication: "Municipal ordinances prescribe that electric cars shall not run at a higher rate of speed than nine miles in the business sections, with trailers, 7.2 miles; in residential sections, 10.8 miles an hour, or nine miles with trailers, and in the suburbs, fifteen miles, or twelve miles with trailers. The penalty for exceeding the speed limit is a fine of $15 or imprisonment for fourteen days, or both. In case of an accident, a higher penalty may be inflicted."

## *HIGH-SPEED ELECTRIC RAILWAY PROBLEMS.*[1]

BY A. H. ARMSTRONG.

Among the many questions to be considered in a new railway project, perhaps the one of primary importance is the question of a proper speed at which to run the road, as depending upon this factor is not only the first cost of the road, but its cost of operation and probable receipts. It is the purpose of this paper to touch briefly upon some of the fundamental relations existing between first cost of a railway system, its probable cost of operation and schedule speed, discussing also the probable traffic receipts to be secured with different methods of operation. In considering so broad a problem in a paper of this length, it will be necessary to omit detailed proof of many of the statements made, but the method of arriving at the conclusions will be outlined. Most of the data presented is obtained from a very elaborate series of experimental tests, so that the results obtained may be considered of direct practical application.

Owing to the wide field covered by the electric railway motor, it is not possible to consider all classes of railways and therefore this discussion is limited to the relatively high-speed roads. It is a mistaken idea that acceleration problems are met with only in city or elevated work where the stops are frequent. Although the so-called high-speed roads stop at comparatively infrequent intervals, the relation existing between stops and schedule speeds often calls for the most serious consideration of fractional speed running of the motors. Such roads really act as tributaries to large city street railway systems and must be able to operate over several miles of city tracks at slow schedule and with frequent stops, and also be adapted for operation at forty or fifty miles per hour, with infrequent stops on a private right of way.

While each road presents its own local characteristics, they can generally be divided into two broad classes, those having frequent stops and those having very few stops. Both classes of service will probably parallel one or more steam lines and must make a schedule speed that will compare favorably with that obtaining on the competing steam road. This high schedule speed must also be made with more frequent stops than given by the steam service, and in nearly all cases over a track which has many sharp curves,

[1] A paper presented at the twentieth annual convention of the American Institute of Electrical Engineers, Niagara Falls, N. Y., June 29 to July 3, 1903.

which have the effect of still further increasing the number of stops. Interurban roads having very infrequent stops, say one stop in five or ten miles, private right of way, and an alignment free from curves of less than three degrees, can give a service equal or superior to any competing steam line, and can furthermore provide the frequent service which has proved one of the valuable assets of electric roads. Moreover, the generating station, feeder system, motor capacity and power consumption will be moderate in first cost. The problem of high-speed electric service therefore is a comparatively simple one, provided the alignment is free from sharp curves and the stops are very infrequent, and such a service can be operated at a less cost and will attract more traffic than the competing steam line with its anti-

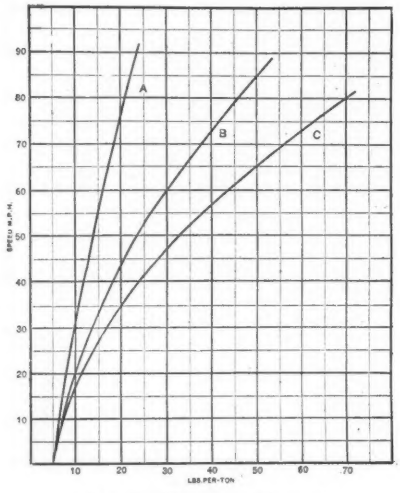



FIG. 1.—FRICTION CURVES.

quated method of operating with steam locomotives.

Suburban roads, however, that pick up their load at frequent intervals along the route and still have to compete with parallel steam lines, present problems much more difficult to solve from an economic standpoint. It is the custom of such roads to establish stopping points, say one mile or less apart, and stop at these points only on signal. During certain portions of the day, however, cars will be obliged to stop at nearly all these stations, and will either fall behind their schedule at such times or will have too much leeway during the remainder of the day when stops are much less frequent. Moreover, owing to the considerable city running at necessarily slow speeds, these suburban roads must make as good time as possible on the suburban route in order to bring the passengers from the more distant points within a reasonable time, including city running. In fact, such roads when paralleling steam lines operating on private right of way through the city, and moreover giving excellent service morning and night to commuters, are compelled to face very serious engineering and economic problems due to the tremendous amount of generating apparatus, line copper and motive power required to give equally good service.

A suburban road will develop a considerable amount of traffic, due to its frequent service, but there comes a time when such roads will extend beyond the zone of half-hour runs into the city and try to reach the outlying districts hitherto belonging exclusively to the steam lines. The frequent service will always be a valuable asset and one that can not be duplicated with the steam locomotive, except at higher cost of operation, but if it takes considerably longer to reach the city by means of the electric line than by the steam road with its better facilities for high speed, the electric line will fail to obtain the proportion of suburban business to which it has been accustomed in its more limited scope. In other words, it fails in its purpose, due to the frequent stops to which its previous popularity was due.

In considering the proper speed at which to operate a new electric line, it is necessary therefore to go very carefully into local details and especially canvass the competition with existing steam lines not only when operated in their present form, but also consider the possibility of their adopting electricity as a motive power.

In considering the possible speeds of a car or train of cars, the investigator is met with the necessity of obtaining some accurate data on the question of car and train friction. The greater part of the data now existing on this subject has been obtained with trains hauled by steam locomotives. Many of these results were obtained by draw-bar pull and hence neglected the wind-friction of the locomotive, and those taken by indicator diagrams are open to the objection that the steam locomotive is not square ended like a car and wind-friction results so obtained are not applicable to the operation of the train electrically without locomotive. Moreover, all these results were obtained with more than a single car in the train and do not apply to suburban electrical operation which almost universally uses single car trains. Tests are being made from time to time with electrically operated trains, and due to the refinement of the carefully calibrated voltmeter and ammeter it is possible to obtain wind-friction values at various speeds and with different number of cars in a train with greater accuracy than in the previous steam tests. These results are not at all complete and the only attempt known to the writer to obtain friction values with different number of cars was made by Mr. W. J. Davis, Jr., through the courtesy of the International Railway Company on its Buffalo & Lockport line in March, 1900. Using these tests as a basis, the writer has drawn up three friction curves in Fig. 1, designating them A, B and C.

The C curve will hold approximately for single car operation where the car weighs in the vicinity of forty tons. The B curve applies to the operation of two such cars in a train and the A curve to a train of such cars, say eight or more in a train. These curves are not published

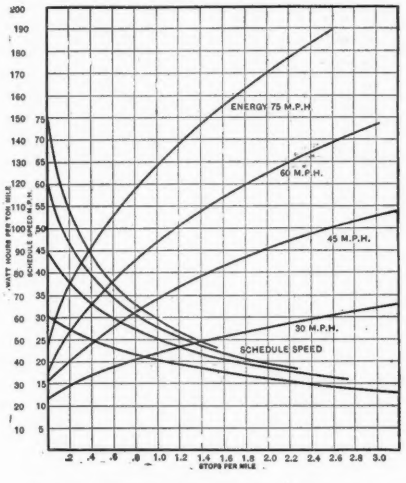



FIG. 2.—SPEED AND ENERGY CURVES. A—FRICTION CURVE.

with the idea that they are correct, in fact the speeds at which they were obtained do not exceed sixty miles per hour, and hence extension beyond this speed is based upon a formula which will follow curve shape up to sixty miles per hour. As the results obtained by using them are not dependent upon their numerical values, intermediate points being easily interpolated, it is not of prime importance that the three friction curves given represent accurately the conditions as set forth. In fact, with the different shaped cars now in use and the different cross-section of cars having the same weight, etc., it is hardly possible to make one friction curve which would apply accurately to all cases. It is probable, however, that the curves given have the general shape and the numerical values applying to average conditions. The friction curves have been extended to maximum speeds approaching ninety miles per hour in order that questions of motor capacity, train energy, possible schedule speeds, etc., can be fol-

lowed up to maximum speeds equal to or better than those in vogue on the present steam roads. As will be pointed out later in this paper, the consideration of the proper method of operating a railway service at these high maximum speeds leads to very interesting results as determining the size of trains and frequency of service to be adopted.

With the friction curves in Fig. 1 as a basis, the curves in Figs. 2, 3 and 4 have been calculated, showing the possible schedule speeds and energy consumption required for these speeds up to and including seventy-five miles per hour maximum. The method used in making up these curves is similar to that pointed out in a paper entitled "A Study of the Heating of Railway Motors," presented by the writer at the annual meeting of the Institute in 1902. As indicated in that paper, the rate of acceleration and rate of braking do not have a marked effect on the energy consumption or possible schedule speeds for these comparatively high-speed roads. The shape of the motor characteristic also is not a determining feature and can be neglected without introducing a possible error of more than a few per cent. The controlling factor in all of these curves is the friction curves, which includes track, rolling, journal and wind-friction.

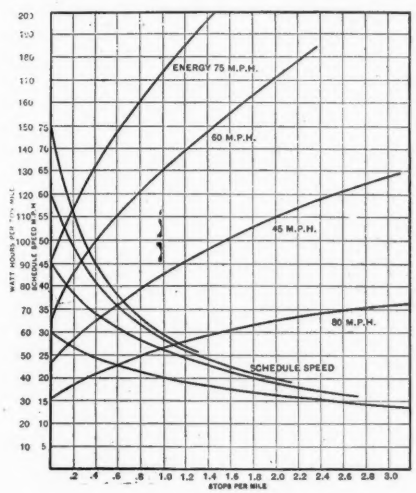



FIG. 3.—SPEED AND ENERGY CURVES. B—FRICTION CURVE.

The constants assumed in calculating the above curves are those pertaining to average high-speed suburban work as follows:

| | |
|---|---|
| Gross accelerating rate | 120 pounds per ton. |
| Braking effort (average) | 120 " " |
| Duration of stop | 15 seconds each. |

Track assumed to be perfectly straight and level.

In the above curves, due consideration is given all the losses occurring during acceleration with the standard series-parallel controller and direct-current motors. If the curves are to be used for alternating-current motors, allowance must be made for the difference in accelerating efficiency of the two types of motors and their methods of control. The inertia of the rotating parts of the equipment generally amounts to five per cent and this value is taken throughout, being perhaps a little high for the higher speeds and low for the lower speeds. The speed curve of a standard 125-horse-power motor is used throughout. The energy curves given are somewhat affected by the amount of coasting done, although this is not so determining a factor in this high-speed work as it is in slow-speed rapid transit accelerating problems. In order that the energy curves should be conservative, they are plotted with only ten seconds of coasting permitted and therefore the schedule speeds given are nearly the maximum possible, and the energy curves given are also practically the maximum possible with the maximum speeds assumed. Should power be shut off earlier and more coasting permitted, the energy consumption would have been decreased and the schedule speeds decreased somewhat also, especially with the more frequent stops per mile.

An inspection of these three sets of curves will bring out the very great effect of the wind-friction when using trains of one or two cars at very high speeds, in fact at seventy-five miles per hour maximum speed the operation of single car trains becomes impracticable with light forty-ton cars of standard construction, and even at sixty miles per hour is questionable. To quote from the curves, it requires an energy consumption of forty-seven watt-hours per ton-mile for a train of several cars, as against 137 watt-hours per ton-mile for a single car operating at seventy-five miles per hour without stops; that is, a single car operation would demand 3.7 times the energy per ton that would be required for the operation of a train of many similar cars. Even a two-car train will require but ninety-two watt-hours per ton-mile, or only sixty-seven per cent of the energy required per ton for single car operation. As these values are for constant-speed running, while more or less frequent stops would obtain, a comparison at, say, one stop in four miles would be nearer the actual results in practice. Here a single car requires 157 watt-hours per ton-mile, a two-car train requires 120 and a train of several cars seventy-nine watt-hours per ton-mile. The results would indicate that in a class of service calling for very high maximum speeds, the tendency of electric roads will be to follow steam railroad practice and operate trains of several cars at more infrequent intervals rather than follow present practice of suburban electric roads and run single cars at frequent intervals. It will be a question for local consideration whether sufficient additional traffic would be gained by the operation of single cars, say on half hour headway, or trains of two or three cars on one hour headway or more, the latter requiring but sixty or seventy per cent of the power per ton moved, and also effect a considerable saving in train crew expenses. As the maximum speed of the service is reduced the difference in energy consumption between single cars and trains of cars is also reduced, and at thirty miles per hour a single car will require but slightly more energy per ton than a train when operated at the frequent stops characteristic of low speed service.

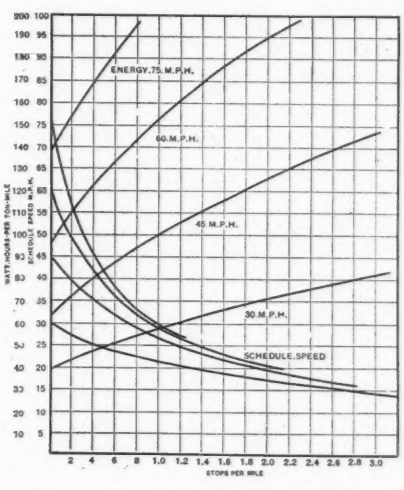



FIG. 4.—SPEED AND ENERGY CURVES. C—FRICTION CURVE.

Another very interesting feature which is well known but perhaps not fully appreciated is brought out by the curves of schedule speeds possible for different maximum speeds. Thus, with one stop in eight miles it is possible to make a schedule of sixty-one miles per hour with maximum speed of seventy-five miles per hour, and a schedule of twenty-eight miles per hour with maximum speed of thirty miles per hour. If stops be increased so that they average one per mile, however, the schedule speed possible with a maximum speed of seventy-five miles per hour is dropped to twenty-nine miles per hour, while the thirty miles per hour maximum speed permits of a schedule speed of twenty-two miles per hour. Thus while thirty miles is but forty per cent of the higher maximum speed it permits a schedule at one stop per mile of seventy-six per cent of that possible with seventy-five miles per hour maximum speed. The fal-

lacy of using high-speed equipments for frequent stops is forcibly brought out by referring to the energy curves in Figs. 2, 3, and 4. With one stop per mile it requires 200 watt-hours per ton-mile with seventy-five-mile maximum speed equipment, and the thirty-mile maximum speed equipment can obtain seventy-six per cent of the same schedule with an expenditure of only 28.5 per cent of the energy. The two values taken for the maximum speed are the extreme, but serve the purpose of bringing out the tremendous price paid for high schedule speeds at frequent stops. The conditions of acceleration and braking are the same in both these equipments, while if higher schedule speeds were required with, say, one stop per mile, a higher rate of acceleration and, if practical, a higher rate of braking would be adopted. The difference in energy values would be considerably reduced thereby, but neither the average rate of acceleration nor the braking could

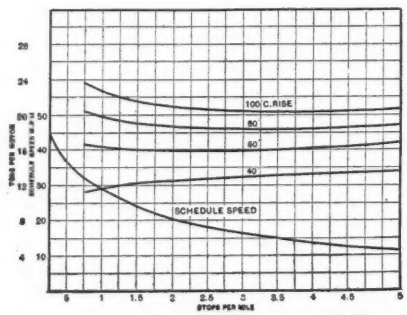



FIG. 5.—MOTOR CAPACITY CURVES, 125-HORSE-POWER MOTOR.
B—FRICTION CURVE.

be very largely increased without incurring the possibility of discomfort to passengers.

Before considering the application of the previous curves to a concrete case, it is necessary to include the effect of the different friction curves at high speeds upon the capacity of the motor equipment. In the paper by the writer at the last annual meeting of the Institute, the manner of fully determining the capacity of a motor for any service was indicated. The details of this method will not be gone into in the present paper, but for convenience a sample motor capacity curve of a 125-horse-power equipment operating at a maximum speed of forty-five miles per hour is shown in Fig. 5.

The means taken to determine the capacity of this motor is to obtain from a series of temperature runs made upon an experimental track the degrees rise per watt loss in different parts of the motor for different ratio losses for armature and field. It is obvious that so long as the motor losses and their distribution are the same, the temperature rise of the different parts of the motor will also be practically the same. This assurance that the car will travel at the same average speed, which is not necessarily the case owing to the fact that the same motor cycle could be obtained with a considerably different train cycle. A service capacity curve similar to Fig. 5 on the 125-horse-power motor is therefore not absolutely correct unless the thermal capacity curves be obtained from actual tests giving the same train cycle as that indicated. It is not necessary to conduct so elaborate a series of tests, as a sufficiently close result can be obtained for practical purposes by obtaining the experimental thermal capacity curves at moderate average speeds upon an experimental track, and assuming that the conditions of ventilation so obtained will hold true for all the schedule speeds. It is admitted that a source of error is thus introduced and that motor service capacity curves will read too conservative at the very high speeds and will possibly be too liberal at the lower speeds; but conservatism at speeds approaching seventy-five miles per hour could not be criticised as poor engineering, and the results given in following curves are therefore presented with full confidence that they will meet a long-felt want and will moreover be approximately correct for types of motors similar to those serving as basis of calculation and experiments.

An inspection of the curves given in Fig. 5 discloses the fact that for a given temperature rise the capacity in tons per motor is practically a fixed amount. For example, a temperature rise of sixty degrees centigrade will be obtained with approximately 16.2 tons per motor over a range extending from one stop in four miles to five stops per mile. It is thus sufficient to associate a given motor and gear ratio with a definite car weight which it can operate with a given temperature rise, and with any schedule speed which the number of stops per mile will permit. This at once affords a means of comparing motors of different capacity by means of the "tons per motor" which is permitted for, say, sixty degrees rise and a given maximum speed equipment. In presenting the curves in Fig. 6, the results of a large number of experiments and calculations are incorporated on motors of similar design giving the relation betwen the commercial one-hour rating of the motor and the number of tons which that motor will carry at maximum speeds of thirty, forty-five, sixty and seventy-five miles per hour. The curves of thirty and forty-five miles per hour are probably accurate, those at sixty miles per hour may be open to criticism of being conservative, and at seventy-five miles per hour with the superior ventilation afforded by the schedule speeds incident to such high maximum speeds, the motor capacity curves perhaps indicate too low a ton weight for sixty degrees rise. As no electric road as yet affords means of obtaining experimental values at this high maximum speed, the degree of error can not be determined and in any case should not exceed more than a possible maximum of fifteen per cent. Figs. 7 and 8 are plotted for sixty degrees also, but using friction curves B and C, so that by means of Figs. 6, 7 and 8 it is possible to determine the capacity of motor required for any maximum speed and any weight of train; while from Figs. 2, 3 and 4, the possible schedule speed and energy consumption can be obtained for any maximum speed and frequency of stops. The maximum speeds of thirty,

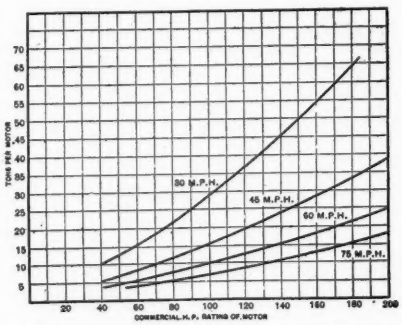



FIG. 6.—MOTOR CAPACITY, 60° C. RISE.
A—FRICTION CURVE.

forty-five, sixty and seventy-five miles per hour have been chosen as covering the present field of electric railroading, and intermediate values may be readily interpolated.

The relation between the commercial one-hour rating of a railway motor and its service capacity performance is very difficult to express. In fact, it is almost impossible to compare two motors, differing essentially in their mechanical design, as the stand-test of a motor has no direct bearing on its service performance with its different distribution of losses and better facilities for ventilation. It is necessary therefore to obtain by experiment the performance of each individual motor under conditions approximating service operation, and determine the relation of stand-test to service operation for the particular motor in question. By carrying on a series of exhaustive tests on each individual motor it becomes possible to plot the results of such tests in curve form and show the relation between stand-tests and service capacity, provided

motors are of the same general design. Having obtained the capacity in tons per motor for different maximum speed equipments, the results were all found to follow the general law noted in Fig. 5; that is, the temperature rise was found to be practically constant over a wide range in stops per mile and schedule speed. With this simplification it becomes possible to compile curves 6, 7 and 8, giving the capacity motor required for any train weight, schedule and frequency of stops, the motors all being of similar design. These curves are all plotted with motors of the closed type, it being assumed that in miscellaneous operation advantage can not be taken of opening ventilators. Where motors can be operated partially or fully open, the capacity, especially at high speeds, will be considerably increased. It is probable, however, that motors operating at speeds approaching sixty to seventy miles per hour will be upon a surface

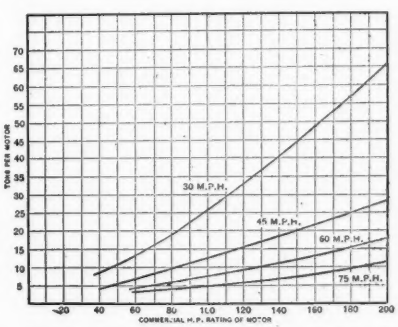



FIG. 7.—MOTOR CAPACITY, 60° C. RISE.
B—FRICTION CURVE.

track where it would be advisable to protect the motor from dust and moisture, and thus operate closed.

The results brought out by curves 6, 7 and 8 are very instructive as determining the probable trend of very high-speed electric railroading where trains of one or more cars are used. For example, a forty-ton car equipped with four motors, thus giving ten tons per motor, will require a 133-horse-power motor for sixty-degree rise when operating a train of several cars at seventy-five miles per hour maximum speed, while the same weight of car would require a motor of at least 230 horse-power, if operated as a single car with the same temperature rise and similar design of motor. That is, the motive power is doubled in going from train to single-car service. Thus not only is train friction the determining feature of energy values, but it is the controlling feature as well of the motor capacity required to perform a given high-speed service.

As pointed out in the earlier part of this paper, it is not necessary that the friction curves A, B and C shall in themselves correctly give the numerical values for train, single-car and two-car work. The general shape of the curves is undoubtedly that pertaining to their respective size of train, and as the three curves are taken and subsequent calculations are all made upon a three-curve friction basis, it is relatively an easy matter to interpolate and obtain the energy, schedule speed and motor capacity required for any train-friction expressed in pounds per ton. The friction curves are of use therefore only in determining the fundamental values of train energy and motor capacity given in the subsequent curves, and the energy, schedule speed and motor capacity can be obtained from these curves whether the friction pertaining to the case in hand is, say, thirty-three pounds per ton at fifty miles per hour for single-car operation, or more or less than this value. The application of the motor and energy curve is therefore universal and it is only necessary to obtain sufficient experimental data of the particular type of car or train proposed to determine accurately its friction for a given maximum speed and obtain the various values required by interpolation in the curves given.

Having obtained the data upon which to base calculations for the proposed electric road, perhaps the best method of showing its application would be to take a concrete case. Let the distance from A to B be, say, 100 miles, or great enough to get over the consideration of location of substations in relation to the length of the line. Assume also that the proposed road will parallel a steam line, or that there are other reasons necessitating a high-schedule speed, and that stops will occur every four miles, will be of fifteen seconds' duration, and that the motors will be direct current supplied from substations fed from a single central generating station. It is desired to know the effect that single-car or train operation will have upon first cost and cost of operation.

It is assumed that the competing steam road will have a schedule speed in the vicinity of forty miles per hour. Such express trains as exceed this schedule will offer such very infrequent service, and will furthermore be so restricted to their through travel that they will not enter as a factor for consideration. By referring to Fig. 4 we find that a schedule speed of forty miles per hour can be obtained with a maximum speed approximately forty-eight miles per hour with one stop in four miles. The energy consumption will be eighty-two watt-hours per ton-mile and the motor capacity will consist of four 110-horse-power motors operating a single forty-ton car with a temperature rise of sixty degrees (Fig. 8). The energy consumed at the car will therefore be 131 kilowatts or 144 kilowatts at the substation bus-bar, allowing an average drop of ten per cent in the third rail. With a substation bus-bar potential at 600 volts, each car will average 240 amperes.

Assuming that the road will be double track with eighty-pound track rails and 100-pound third rail, the distance apart of the substations will be approximately thirteen miles with a maximum drop of 170 volts when two cars are passing midway between substations, one of which is accelerating. This drop is permissible, as it is momentary only. Each substation must be able to accelerate one car and supply another at full speed, or must give 850 amperes momentary output and a sustained output of 500 amperes. The

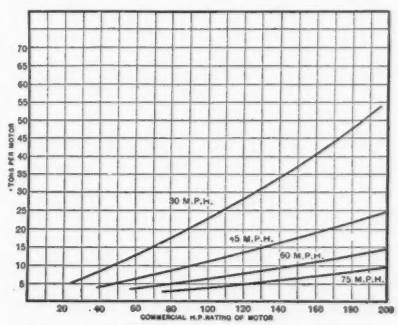



FIG. 8.—MOTOR CAPACITY, 60° C. RISE.
C—FRICTION CURVE.

substation will therefore be called upon to deliver momentarily 510 kilowatts and should contain not less than one 300-kilowatt rotary converter and preferably two, one being a reserve. This size of converter is based upon the assumption that cars run always as single units and not in trains, and that converters can stand a momentary overload of 100 per cent. With half-hour service cars will be spaced twenty miles apart, so that there will be required a generator capacity of two cars every twenty miles (double track) or 340 kilowatts, assuming fifteen per cent loss in rotary converter substations and transmission line. The generating station capacity per mile of track will therefore be seventeen kilowatts, and the substation forty-six kilowatts with reserve, and twenty-three kilowatts with no reserve. Taking the cost of generating station in round numbers at $100 per kilowatt and substation at $35, the cost of a forty-ton car complete with four 110-horse-power motors, controllers, etc., at

$9,000, we arrive at the following approximate cost for installing:

APPROXIMATE FIRST COST PER MILE, SINGLE-CAR TRAIN.

| | |
|---|---|
| Generating station | $1,700 |
| Substations with reserve | 1,610 |
| Equipment (plus 20% reserve) | 1,120 |
| Total | $4,430 |

The above total of $4,430 thus represents the approximate first cost of the various items noted when operating a single forty-ton car every half hour at forty miles per hour schedule speed and stopping fifteen seconds once in four miles. Following through the same process with two forty-ton cars operating on one-hour headway at forty miles per hour schedule with the same track and third-rail construction, we arrive at the following conclusions:

| | |
|---|---|
| Watt-hours per ton-mile | 63 |
| Train energy at train (80 tons) | 202 kilowatts. |
| Distance apart substations | 9.1 miles. |
| Size of substation | two 400-kilowatt units. |

Each train consisting of two forty-ton cars will consume 224 kilowatts at the substation, or 264 at the generating station, allowing the same percentage of loss as above. These trains making the same schedule speed at double the headway will be spaced forty miles apart and the generating capacity will therefore be 528 kilowatts every forty miles, or 13.2 kilowatts per mile. The substations, consisting of two 400-kilowatt units (with reserve) every 9.1 miles, will have capacity per mile of eighty-eight kilowatts. Expense for cars will be the same as before and the following approximate costs obtain:

APPROXIMATE FIRST COST PER MILE. TWO-CAR TRAIN.

| | |
|---|---|
| Generating station | $1,320 |
| Substations | 3,080 |
| Equipments | 1,120 |
| Total | $5,520 |

The first cost of the two-car train system will be $5,520 as against $4,430 with single-car train. The energy consumed for the two methods of operation is seventeen kilowatts per mile of track with single car as against 13.2 kilowatts per mile with two-car train. Thus, while the two-car train at one-hour headway will cost twenty-four and one-half per cent more to install (for the items mentioned only), it will consume but 72.5 per cent of the energy required to operate a single car individually.

The difference in power required is 3.8 kilowatts per mile of track. Assuming twelve hours per day operation at the above headway, the total kilowatt-hours per day will be 45.5, which at $0.007 per kilowatt-hour would be $116.-50 per year, or ten per cent on $1,165. It would therefore pay to invest the $1,090 per mile of track difference in cost between one car and two-car operation, as found above, provided the same receipts could be secured with one-hour headway as with thirty-minute headway. The relation of traffic receipts and frequency of travel is a question which can only be determined experimentally, and while the desirability of the two-car service seems evident from the data at hand in the above case, it might result in a falling off of receipts to such an extent as to more than make up the saving in operating expenses. There is an additional saving in train crew expenses which was not entered into above, and which would amount to something more than half as much as the cost of power. With two-car operation, it is possible to reduce the motor capacity per car from four 110-horse-power motors to four motors of approximately ninety-five horse-power, thus reducing the cost of the equipment item. Owing to the fact, however, that it might be desired to operate a single car during certain parts of the day, which would result in overheating the smaller motor equipment, it would be more conservative to consider the same size of equipment whether one-car or two-car train were operated. With more than two cars in a train, advantage could be taken of the smaller equipment required, but it is probable that in two-car work this advantage of the smaller motor possible for two cars would only result in the cooler operation of these motors when operated in two-car trains and would show up therefore in the repair account rather than as a first cost. The substations with two-car trains being placed somewhat closer together would have a labor account per mile of track in excess of that for single-car operation. This may be balanced against the saving which would result from smaller crew expenses of the two-car train.

The above example serves to illustrate the very broad application of the foregoing curves. Although it has been necessary to assume a number of constants, acceleration, braking, coasting, etc., these constants are those pertaining to average operation and can vary considerably without making a serious difference in the results. The curves given are not therefore absolutely correct, but are sufficiently so for approximation purposes. For the slower speed work where stops are more frequent and where acceleration is a more important factor, it will be necessary to have more complete curves in order to determine the proper rate of acceleration to use, especially if the problem is one calling for very high-schedule speeds in relation to the number of stops.

As previously stated, it is not necessary that friction curves A, B and C should represent the actual friction in pounds per ton of train two-car and single-car work. Having the motor capacity and energy values for three different friction rates at a given maximum speed, it is possible to interpolate and secure the proper motor capacity and energy value for the friction value corresponding to the case in hand. The importance of the wind-friction as affecting electrical operation at a very high speed in a class of service which has followed along the lines of very small light trains of one or more cars, will probably lead to the construction of special cars reducing wind-friction to a minimum when the higher maximum speeds are put into commercial operation. No conclusive data are at hand upon the effect of different shaped car ends on single or two-car operation. When such data become available and special cars are constructed, their operation can be predicted from the foregoing curves by interpolation for the new friction values thus obtained.

The compilation of the above curves entailed a large amount of careful work, and the writer is very much indebted to Mr. E. F. Gould for his very valuable assistance.

### *The Second Annual Report of the Allis-Chalmers Company.*

The second annual report of the Allis-Chalmers Company, for the fiscal year ending April 30, 1903, shows that the net profits, after deducting all expenses of manufacture and selling, and after making full provision for depreciation of buildings, plant and machinery and for possible bad debts, are $1,653,576.06. From this must be deducted the dividends declared on the preferred stock, which amounted to $1,137,500, leaving a surplus of $516,076.06.

Mr. James Stillman, of the National City Bank, New York city, and Mr. Charles Allis were made members of the Finance Committee. No other changes were made in the officials, committees or superintendents.

The executive officers of the Allis-Chalmers Company are: Chairman of board of directors, Elbert H. Gary, New York; president, Charles Allis, Chicago, Ill.; vice-president and treasurer, William J. Chalmers, Chicago, Ill.; second vice-president, Henry W. Hoyt, Chicago, Ill.; third vice-president, Philetus W. Gates, Chicago, Ill.; fourth vice-president and secretary, Joseph H. Seaman, New York; assistant secretary, Joseph O. Watkins, Chicago, Ill.

### *The Telechirograph.*

The telechirograph is a new telautographic apparatus which has been invented and developed by Herr Ernst K. Gruhn. Views of the apparatus are given in the accompanying illustrations. All of the mechanism, except the writing pencil, is contained within a polished hardwood box, thirteen by thirteen by fifteen inches. This contains the apparatus for transmitting, and that for receiving and recording messages.

To send a message, it is written on the blank, seen on the top of the box, by the stylus. The action of taking the stylus out of its rest automatically brings the recording apparatus at the other end of the line into service, and this reproduces exactly the marks made on the first blank. After a message is completed, the act of placing the stylus back in its holder throws the recording apparatus out of action, and starts a small motor operated

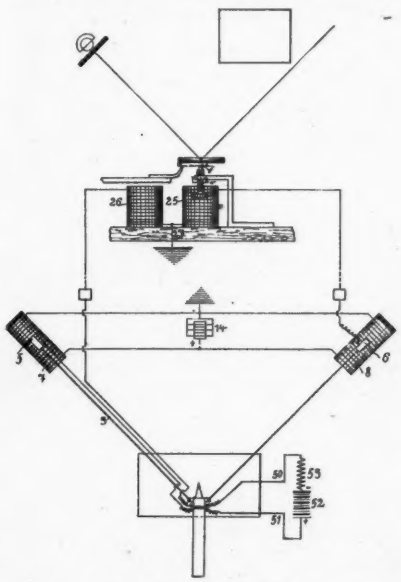
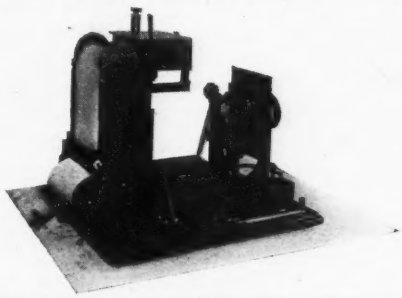


DIAGRAM OF CIRCUIT.

by an independent battery which delivers the message, and at the same time turns off a small incandescent lamp which was lighted when the stylus was picked up, and which is used in recording the message. The message is delivered from the slot in the side of the box, as seen in the illustration.

The principle of the apparatus is very simple. As the message is written by the stylus, the motion of this is decomposed into two components, at right angles to each other, and these two components act to send over the line corresponding electrical currents. At the other end of the line these currents are used to produce deflections in two planes at right angles to each other, of a small concave mirror, and by this means the two components are combined to give a record by means of a ray of light reflected upon a sensitized screen which is an exact reproduction of the original.

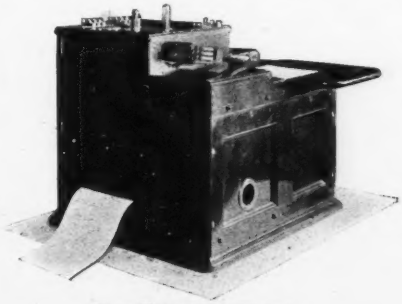
By referring to the diagram the method of operation will be made clear. Nos. 7 and 8 are two resistance coils, which are connected to the terminals of the battery 14. There is, then, a constant fall of potential through these two coils. Press-



THE TELECHIROGRAPH, WITH COVER REMOVED.

ing upon the sides of these coils, and in this way making contact at different parts of the coil, are two brushes 5 and 6. These brushes are fastened to the stylus by the bands 3, 4, and are also drawn toward the extreme end of the resistance coils by two light springs, not shown. From these two brushes wires are carried to the transmitting circuit. At the receiving end of the line these wires are connected to two coils 25 and 26, and the other ends of these coils are connected to the ground of a common return. One end of the battery is also connected to the ground or a return wire. Thus, the motion of the stylus is utilized to send over two lines two currents, which vary according to the components of motion, the variation being caused by the change in resistance of the circuits and the change in electromotive force applied to them.

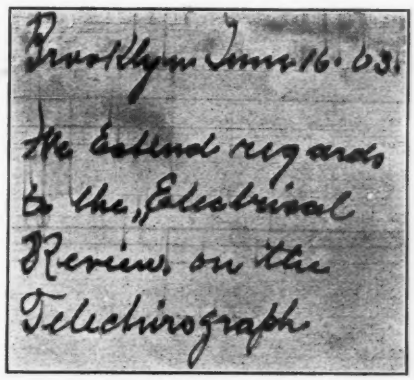
At the receiving station these two currents are passed through the two coils,



THE TELECHIROGRAPH.

and thus serve to attract suitably placed armatures. The mirror is cemented to a triangular piece of iron, and supported on three points, one being fixed and the other two attached to the two armatures. The mirror is concave and focuses a ray of light from a small incandescent lamp upon a strip of sensitized paper. The mirror then follows every motion of the armatures. In order that this motion may be proportional to the current passed, the iron core of the coils is rather short, so as to leave a considerable air-gap; and oscillations of the armature are prevented by suitable damping pistons attached to the armature, and moving in some viscous liquid.

The description so far given shows how every motion of the stylus is followed by the mirror; but in a practical instrument this is not sufficient, for no record should be made when the stylus is not pressed against the paper. To meet these requirements the stylus is arranged so that one transmitting circuit is open whenever the stylus is lifted from the paper. There are on it two sleeves, which are held apart by a light spring, to one of these is connected the wire from one of the moving brushes, and to the other, the wire leading to one transmitting line. Thus, when the stylus is pressed against the paper,




A MESSAGE TRANSMITTED AND RECORDED BY THE TELECHIROGRAPH.

the two sleeves come together and complete the circuit. When the stylus is lifted from the paper this circuit is not only opened, but an auxiliary battery, which is connected to the two sleeves, is connected into this circuit, and this serves to send through the line a current strong enough to throw the beam of light entirely off the sensitized strip.

The two resistance coils are made of insulated resistance wire, wound on a cylinder as close together as is possible; and then a strip of insulation is removed along the path of the brush, leaving the wire bare. This construction, of course, varies the resistance in small steps, and not perfectly uniformly; but this is satisfactory for all practical purposes. Moreover, since in an instrument of practical size the bands connecting the stylus and the two brushes must be rather short, distortion will be produced by the angularity of these bands. This distortion, the in-

ventor states, is prevented by a corrective device, patents on which are pending, so that it can not be described now.

Two of these instruments are at present on exhibition in Brooklyn, where messages are sent and received from one room to another. The two instruments were first set up and operated in separate buildings, but as visitors desired to see both operations, it was found more convenient to bring them into the same building. It is stated, however, that they have been operated successfully between Dresden and Berlin, a distance of about 125 miles. They, of course, can be used to transmit drawings, as well as written messages. One of the illustrations shows the apparatus with the cover removed. This differs in some details from the description just given, but it serves to show the simplicity of the mechanism. To the left is seen the roll of sensitized paper. Below this, but not seen in the illustration, is the developing bath, and above, and just to the right of the roll, is a reservoir of developing solution. In front, on the left corner of the base, is a small magneto motor, which is automatically thrown into operation when the stylus is placed in its holder. This slowly unrolls the paper, passes it through the developing bath, and then through drying rolls, finally delivering it through the opening in the box, where it falls into the fixing bath. This operation takes, at present, about thirty-five seconds, but it can be done in considerably less time. To the right of the illustration can be seen the two deflecting coils and a telescope for throwing the beam of light. In this particular instrument two mirrors are used, one reproducing the horizontal components, and the other the vertical components of the original motion. The beam of light issuing from the small telescope strikes the first mirror, is reflected from this to the second, and thence on the sensitized paper. The beam of light has the advantage over a mechanical device in not possessing inertia, and the apparatus will record a message as rapidly as it can be written. Three transmitter lines are required, two outgoing and a common return, though the latter may be merely the protecting sheath of a two-conductor cable.

The instrument can be used over an ordinary telephone line, and can be arranged to be cut in and out of circuit by the act of removing or replacing the telephone receiver. It is thought that it will find application where it is necessary to have a written record, and in this way may supplement the telephone. It may also be useful in transmitting portraits and in other work of a similar character.

The telechirograph is covered by American and foreign patents. It is being developed in Germany by the Kopier Telegraph Gesellschaft, and in this country by the inventor, Herr Gruhn, and Mr. Max Herzka. The offices are at present at 44 Court street, Brooklyn, at the law office of Mr. Thomas Fitzhugh Lee, who is counsel for the company.

### *Union Engineering Building.*

A formal organization of the joint committee representing the various bodies which have taken action with respect to the gift of one million dollars of Mr. Andrew Carnegie for a union building, was effected on the evening of June 18. The American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Engineers' Club have taken final action and appointed their representatives upon a joint committee for accepting the gift. The American Institute of Mining Engineers has likewise taken action, in so far as its rules permit. Its council has appointed representatives subject to changes in the rules of the organization, which have been proposed by the council for adoption at the next general meeting. At the present time a letter ballot for ascertaining the attitude of the members is being taken which shows an overwhelming majority in favor of the plans proposed by the council.

The American Society of Civil Engineers at its recent meeting in Asheville referred the matter to its board of directors for recommendation, and directed that the matter be then presented to the members of the society for letter ballot.

At the meeting on June 18, the following were announced as representatives of the several bodies upon the joint committee:

American Institute of Mechanical Engineers—James M. Dodge, F. R. Hutton, Charles Wallace Hunt.

American Institute of Electrical Engineers—Charles F. Scott, B. J. Arnold, S. S. Wheeler.

American Institute of Mining Engineers—A. R. Ledoux, Charles Kirchoff, Timothy Dwight.

Engineers' Club—John C. Kafer, W. H. Fletcher, W. A. Redding.

Representatives of the American Society of Civil Engineers are requested to meet with the joint committee and take part in deliberations with regard to the plans to be adopted. The representatives who have served upon the conference committee are: Alfred Noble, W. J. Wilgus, George K. Pegram.

The joint committee was organized by the election of the following officers:

Chairman, Charles F. Scott; secretary, Professor F. R. Hutton. The chairman was directed to indicate to Mr. Carnegie the acceptance of his gift by the joint committee representing the several organizations.

The joint committee placed the immediate work of developing plans upon an executive committee of five, consisting of one member from each of the five organizations named in Mr. Carnegie's letter, as follows:

American Society of Civil Engineers, Mr. Alfred Noble.

American Society of Mechanical Engineers, Professor F. R. Hutton.

American Institute of Mining Engineers, Mr. A. R. Ledoux.

American Institute of Electrical Engineers, Mr. Charles F. Scott.

Engineers' Club, Mr. W. H. Fletcher.

The executive committee met on May 19 and organized by the election of Charles F. Scott, chairman, and F. R. Hutton, secretary. The committee laid out certain work to be undertaken by its several members, and will have meetings from time to time during the summer.

The following cablegram has been sent to Mr. Carnegie:

Andrew Carnegie, Skibo Castle.

Joint committee four organizations formally accepts generous gift union building. Executive committee in session sends greeting and reports progress.

SCOTT.

### *Michigan Telephone Company.*

The annual meeting of the Michigan Telephone Company was held at the company's offices in Detroit on Monday, June 22. Vice-president H. J. Pettingill presided, in the absence of President Dexter. The report of the treasurer, read by Mr. George W. Leverett, of Boston, general counsel for the Western Telephone Company, showed that the earnings of the company for 1902 were $1,549,531. The expenses for the same period were $1,632,230, leaving a deficit of $82,699. The total deficit, as shown by the ledger balances December 31, 1902, amounts to $501,296. Loans and accounts payable on the same date amounted to $2,538,176. The statement was made that since the company has passed under the control of the Union Trust Company, as receiver, the present officers can not create any further debts. No salaries are being drawn by the executive officers, and the entire purpose of the meeting was to keep the organization together and to have officers to represent it in court. The debts for labor and material, for which the stockholders will be individually liable, were paid up to the time the receiver was appointed. A motion was made by Mr. Leverett to approve of the acts of the board of directors and executive committee for the past year. Upon the reading of the entire records from the time that the directors met in Boston after the last annual meeting for organization, the vote was cast and the acts ratified. The number of shares represented, either in person or by proxy, was 39,112. There was no opposition to the reelection of the old board, as follows: Mr. Philip Dexter, Mr. Frederick P. Fish, Mr. W. S. Hutchinson, Mr. H. J. Pettingill, Mr. Hugh McMillan, Mr. Thomas Sherwin and Mr. Dudley E. Waters.

# *Twentieth Annual Convention of the American Institute of Electrical Engineers Held at Niagara Falls, June 29 to July 3, 1903.*

*Proceedings of First Two Days.*

INSTITUTE AND PRESIDENT'S DAY, JUNE 29.

THE twentieth annual convention of the American Institute of Electrical Engineers was opened at 10.30 Monday morning, at Niagara Falls. The first session was well attended for a gathering beginning on Monday at a place which required nearly all in attendance to make a long railroad journey to reach. Many members from a distance made the trip during Sunday, reaching Niagara Falls Sunday night, and these, together with those who arrived on the morning trains, made a very creditable showing at breakfast at the International Hotel. Headquarters were opened at the Cataract House, and registration of members and guests began at once, about 200 registering the first day.

The weather was beautiful; a mild, bright, summer day. This was all the more welcome as the weather during the early morning hours was quite threatening and heavy rains fell farther to the east. The country was fresh and green.

Members were in attendance from all sections of the country, and were enthusiastic in anticipation of taking part in a convention which promised to be second to none in pleasurable features, as well as in the presentation of interesting and valuable papers.

The first session was called to order by President Charles F. Scott at 10.30 A. M. in the excellent auditorium of the Natural Food Company's building, which, through the courtesy of the Natural Food Company, had been tendered to the Institute as a meeting place throughout the convention. President Scott spoke of the advantages and attractions which had led to the selection of Niagara Falls as the meeting place, and introduced Mayor Hancock who, in welcoming the members of the Institute, gave a brief sketch of the old Niagara Falls before the days of the electrical development, and spoke of the rapid development of the town, where there are now about 25,000 inhabitants. He expressed his pleasure in tendering the freedom of the city and a whole bunch of keys to the members of the Institute.

President Scott expressed the obligations of the Institute to Dr. Samuel Sheldon, chairman of the committee on papers; to Professor G. F. Sever, chairman of committee of arrangements; to Mr. H. W. Buck, chairman of the local committee, for their interest and labor in providing for the success of the convention and the comfort of the members.

Secretary R. W. Pope read invitations to members and guests to visit the plants of the Niagara Falls Hydraulic Power and Manufacturing Company, from the Niagara Falls Power Company to a reception and to visit the plant, and from the Natural Food Company. The Niagara Club extended to all members of the Institute the privileges of the club-house.

President Scott delivered his presidential address, reviewing the work of the Institute for the past year. He said in part:

The work of the electrical engineer is unique. He deals with kinetic energy rather than static. His work lies in the field of action. His unit is the kilowatt, the unit of activity. The engineer has been defined as one skilled in the use of materials and forces of nature, but the electrical engineer is one who deals with the forces.

Electricity enters into other things as nothing else does. It is not a thing alone, and this explains the rapidity of its development, and its far-reaching application. He illustrated this by referring to the railway motor, which was first introduced as a clean substitute for the horse, but it had brought greater speed, larger cars and more comfort, and was now bringing about a redistribution of population. Similar changes have taken place in telegraphy and telephony, and he spoke of the newness of certain branches of electrical engineering, such as alternating-current transmission. This industry is only a few years old, but to-day plants are operating at 50,000 volts or more. The United States census shows that the mean rate of increase in the electrical industries is twenty per cent a year.

The technical schools have in this time shown a tremendous growth, but they are not yet able to supply the demand for trained men.

Electrical engineering is the centre about which all other branches cluster, because it more than any other comes in touch with the others. This point was illustrated by the New York subway where the primary object is to move trains, but where all the engineering connects with electricity and everything is adapted and contributes to the electrical equipment. For these reasons the electrical engineer, more than all others, should know more about and be in closer contact with other branches of engineering.

The Institute is the youngest of the engineering bodies, and it was for the members to decide in what way it could be made to contribute most to the welfare of its members and the world. It has no past to look back to. Shall it follow the lines taken by the older societies, or strike out for itself? What are the new conditions and how may these best be met? The Institute can not stand aside. It must be in and of the strenuous life. The efficiency must be increased. The local branches have accomplished much to this end during the past winter as these help distant members to take active part in the Institute matters. The membership has increased during the past year nearly 1,000, nearly sixty per cent of these members being between the ages of twenty-five and thirty-five, that is, in their active life and this meant much to the Institute. Seventy-five per cent of the new members has graduated from technical colleges in the last ten years. Figures were given showing the distribution of membership in the various lines of work.

President Scott spoke of the crystallization now going on in electrical engineering and referred to the work of the Institute committees on standards and transmission in this connection. This work will be of the highest value to the Institute and its members as bringing together the latest information.

The growth of the library was mentioned, and it was stated that a general index of the Institute transactions would be got out both in bound form and as a card index, which will be of great value in making the work of the Institute available.

President Scott, in referring to the $1,000,000 engineering building which has been offered to the engineering societies by Mr. Andrew Carnegie, gave a short sketch of the conditions which led up to the offer and stated that four out of five of the engineering bodies have accepted the gift and are now developing the plans. He spoke of Mr. Carnegie's ideal, which is to bring the various engineering bodies together so that each may benefit socially and professionally by the acquaintance of engineers in other lines of work. Co-

operation among engineers is not less necessary than in commercial life, but individual freedom and life must be preserved. Mr. Scott hoped the electrical engineer would be the unifying medium.

Four things must be considered in the development of the Institute.

1. Plans should be outlined to broaden the work of the Institute, making it unnecessary for other special bodies to be organized. Standing committees might be appointed to look out for the various lines of development.

2. Affiliations should be established with other societies, both in this country and abroad.

3. Local branches should cooperate with other local engineering bodies.

4. Cooperation with other national societies should be begun, with a view to establishing a national engineering congress which should consider questions of general engineering interest.

President Scott spoke of the spirit of the men who had given their time and thought to promoting the Institute affairs, as being of the greatest help.

To carry out the plans for the building, money is needed, and it seemed only just that those interests which have benefited most from electrical development, and which will benefit by the work of the Institute, should aid generously in carrying out these plans. However, all these things, building, books, etc., are only tools for the men and it is men that are needed and must be developed.

The advantage of having a social club convenient to the engineering building was thought to be considerable, and the commercial side of engineering was touched upon as an important phase not to be neglected.

President Scott's address was well received, and at the conclusion he called upon Professor W. S. Franklin to read his paper upon "The Energy Transformation in the Synchronous Converter."

In presenting this paper Professor Franklin said it had not been prepared as an Institute paper, but was the result of a private study. He did not attempt to abstract it, but called attention to his statement of the criterion which enables one to judge of the physical reality or unreality of the component parts into which a physical aggregate is resolved by mathematical analysis, and it suffices to state that this criterion shows the physical unreality of synchronous motor activity and direct-current generator activity as component parts of the activity of the synchronous converter.

The synchronous converter was then compared with the autotransformer, as in both machines energy is transformed both conductively and inductively. Figures were given showing to what extent the actions take place in converters having two, three, four and an infinite number of slip rings.

In the discussion Dr. Samuel Sheldon stated that there never could be but one current flowing in a circuit and that this is always in phase with itself. In analytical discussion it is correct to consider the two phases of a current, the wattless and the watted, but as a physical reality this will not do.

In the synchronous converter there must be both motor and generator activities and these exist respectively in those inductors in which the current is flowing in such a way as to set up the actions. This does not agree with Professor Franklin's statement.

Professor Sheldon had handled the problem by plotting time-current curves, using a straight line for the direct current and a suitable templet for the alternating current. This allowed treatment of any shape of wave. His work has given results which agree with Professor Franklin's calculations, and it has the advantage that real converters may be considered and not merely the theoretical case where the wave is sinusoidal. Professor Franklin explained that his statement was to the effect that as in the synchronous converter not all the elements are present, such as mechanical drive of the direct-current generator and mechanical output of the synchronous motor, it is not proper to treat it as a direct-current generator.

Mr. W. L. Waters read a paper entitled "Commercial Alternator Design." Different types were compared, and attention was called to the ventilation of the armature and field. He advocated large machines and the use of saturated fields to get good regulators.

It was suggested that the Institute revise the clause in specification for testing alternators and require them to be tested at zero power-factor, as this is easily done and shows the performance under the worst conditions.

Mr. D. B. Rushmore gave a brief abstract of a paper which will be given as a communication to the Institute later. He spoke of the peculiar conditions which are sometimes met in transmission work, where at times problems having nothing to do with the operation of a machine influence the design. The line characteristics are the most important and the water drive differs from the engine drive. Effects of lightning can not be disregarded.

The problem of securing good insulation is serious, and for transmission work the factor of safety must be higher than for other work. A low specific inductive capacity is desirable as well as a low dielectric hysteresis loss. Heat tends to bring about deterioration of insulating material, and this must be provided against. Mechanical strength is often necessary. The effect of star and delta connections was touched upon. Capacity tends to exaggerate the higher harmonics, and a case was mentioned where there was a cross-current of the third harmonic, equal to the full load current flowing in an armature. The advantages of the inductor type of machine were touched upon, it being stated that good regulation, say four per cent, could be obtained.

Emphasis was laid upon the difference between armature reaction and armature inductance. One or two ideas generally held of the armature reactions were questioned, and as a specific case experiments had shown that cross-magnetization did not weaken the field, although it is usually believed that with saturated pole tips one tip is weakened more than the other is strengthened.

The behavior of an alternator on short-circuit was alluded to with the statement that here there is a direct current superimposed upon the alternating current, the former slowly dying out.

Mr. R. D. Mershon thought that Mr. Waters's requirements were too severe. If a thirty-degree temperature rise is required it will have to be paid for. A forty-five-degree rise is good enough. He referred to several European machines he had inspected, and while praising the mechanical work, criticised the electrical part. He thought European switchboard practice bad, as no provision is made to disconnect a line when short-circuited, the whole station must be shut down.

Professor H. J. Ryan stated that the Institute Standardization Committee had under consideration a new clause covering the testing of alternators, and it hoped soon to be able to give it out.

In reply, Mr. Waters did not think it desirable to leave a machine in on short-circuit, and he did not think an inductor machine could be compared in dollars and cents to the revolving field type. He emphasized again that alternator design is a question of empirical rules and not of theory. It is no more expensive to give good ventilation than poor.

In the absence of Mr. Calvin W. Rice, who has left for a trip to Europe, his paper on the "Institute Branch Meetings, Their Organization, Development and Influence," was read by Professor W. E.

Goldsborough. This reviewed the work of the Institute in establishing the local sections. Much credit should be given to President Scott for the success of this movement, which had done so much to increase the Institute membership. Suggestions for conducting these branches were given and the advantage to the local members and to the Institute were touched upon. Development could best be secured by making one man responsible.

Professor H. J. Ryan spoke of the great success which had attended the Cornell branch.

Professor W. E. Goldsborough told what had been accomplished at Purdue and at St. Louis, and Mr. Peter Junkersfeld spoke of the work of the Chicago branch.

In the afternoon the members visited the plant of the Niagara Falls Hydraulic Power and Manufacturing Company, where about 40,000 electrical horse-power is being developed for use in electrochemical and other works. Visits were also made to the plant of the Natural Food Company, where more than 1,000 kilowatts are used in electrical cooking ovens.

On Monday evening, at the auditorium of the Cataract House, Dr. Max von Recklinghausen made an interesting exhibit and gave an historical sketch of the mercury vapor lamp. He described the various types of lamps and accessories, and showed a number in operation.

Mr. Percy H. Thomas then described the Cooper Hewitt vapor converter for three-phase circuits, illustrating its action with diagrams showing how the alternating current could flow one way only, thus giving a direct current. He then passed to an interesting and important development in this work—the single-phase converter. When a two-phase current is passed through a simple converter, there is one part of the cycle when neither phase is forcing current through the converter. The negative electrode resistance then reestablishes itself, and the converter goes out of action. If, however, a small amount of current is kept flowing during this time, the negative electrode resistance can not re-form, and the converter acts continuously. Two types of apparatus were shown, both being glass globes about ten inches in diameter.

In the discussion of the converters, the high efficiency was pointed out. It is not yet known what is the limit in capacity, but the promise is given that these will be most important in railway work. Dr. von Recklinghausen then showed how the principle of the single-phase converter could be used in the alternating-current mercury vapor lamp, showing one in operation. This had three positive electrodes sealed into the upper bulb. The tube is about four feet long, and has a bulb at the base containing the mercury.

Mr. Thomas then described the application of the negative electrode resistance to a circuit-breaker for alternating currents. The apparatus would have a conducting metallic circuit enclosed within a mercury vapor globe. If an excessive current should pass, this would open the metallic circuit and establish a mercury vapor arc, but this arc would go out quietly, and not be reestablished when the current reached its zero value. It is thought that this apparatus might take the place of the elaborate oil-break switches.

ELECTRICAL DAY, TUESDAY, JUNE 30.

The Tuesday morning session was opened with the reading of a paper by Mr. A. H. Armstrong, on "High-Speed Electric Railway Problems." This paper brought out in detailed fashion the relation of energy consumption to wind-friction, and the peculiar conditions which prevail under different rates of acceleration and overall speeds. This paper appears in full on other pages of this issue of the ELECTRICAL REVIEW.

Mr. Frank L. Sessions then read his paper, entitled "Storage Battery Industrial Locomotives." This paper was discussed, in the main, by Mr. A. H. Berry, of New York, who laid special stress on the importance of the durability of the battery. Mr. Berry had run one battery for four years, and it was still in good condition. Charging the battery from a trolley circuit was not practical, due to the variations in voltage. While it was important to design the battery to give the best kind of service, special attention should be given to the construction of the locomotive, in order that friction losses might be abolished as far as possible. It seemed as if the efficiency given by the battery was low. When selling the battery, the customer should be given the charging rate of the battery. Means should be effected to protect the battery when connected for high speeds.

Mr. Elmer A. Sperry, of New York, emphasized the value of battery locomotives compared with compressed air, stating that the battery locomotive gave a higher efficiency and a greater capacity per pound for the battery. The storage battery locomotive was very useful in mining applications.

In reply, Mr. Sessions said that the efficiency was not of very great importance. The values he had given were only approximate. The battery could be charged practically from the trolley circuit. The charge rate depended upon the type. A special circuit-breaker was devised to protect the battery when connected for high speed.

The paper contributed by Mr. F. W. Carter, on "Predetermination in Railway Work," was read by Dr. Samuel Sheldon. Mr. C. O. Mailloux, of New York, described his method. This paper was considered a step in the right direction, as an equation is wanted connecting time values with speed values.

Dr. W. E. Goldsborough read a paper on "Car Run Tests," which he had compiled with Mr. P. E. Fansler.

Following this, Mr. E. F. Sherwood, of New York, described an interesting test on the Northern Texas Traction Company's cars, of three different types.

Dr. Samuel Sheldon read a paper on "Some Recommendations Concerning Electrical and Mechanical Specifications for Trolley Line Insulators." This paper was discussed with considerable interest, Mr. Joseph E. Sachs, of Hartford, Ct., contending several points. Surface leakage, he said, was to be seriously considered. The insulator must remain intact, though punctured. In testing, the insulator could be raised to the melting point, but at the expense of the insulation. The heat test might be carried too far. The test should be made under practical conditions, where the collection of dust and dirt would be taken into consideration. A large surface was necessary to prevent surface leakage.

Mr. Ralph D. Mershon suggested the use of direct current in testing, as better results could be obtained, with less heating. Tests that he had made showed this. On testing with alternating currents, the insulation would get hot and soft.

Replying, Dr. Sheldon said that the alternating current was correct for testing, as the test could be made in so short a time that no heating would result.

"The Storage Battery in Substations," by Dr. W. E. Goldsborough and P. E. Fansler, was read by Dr. Goldsborough. This paper was followed by a paper by Clarence Renshaw, on "Notes on the Operation of Railway Motors in Service."

Dr. C. T. Hutchinson described some curves showing the behavior of any motor under any condition. The computations from these had agreed with tests, and justified the method. This discussion was answered by Dr. Goldsborough. The test had been made to operate without battery, but the strain on the station had been too severe.

The attendance at the sessions was quite large, over 300 members being present.

In the afternoon a technical tour of inspection was made of the electrochemical and other electrical installations operated by Niagara Falls power, and the power-houses of the Niagara Falls Power Company.

In the evening there was a reception by the Niagara Falls Power Company, and a dance, under the auspices of the Local Committee, at the Cataract House.

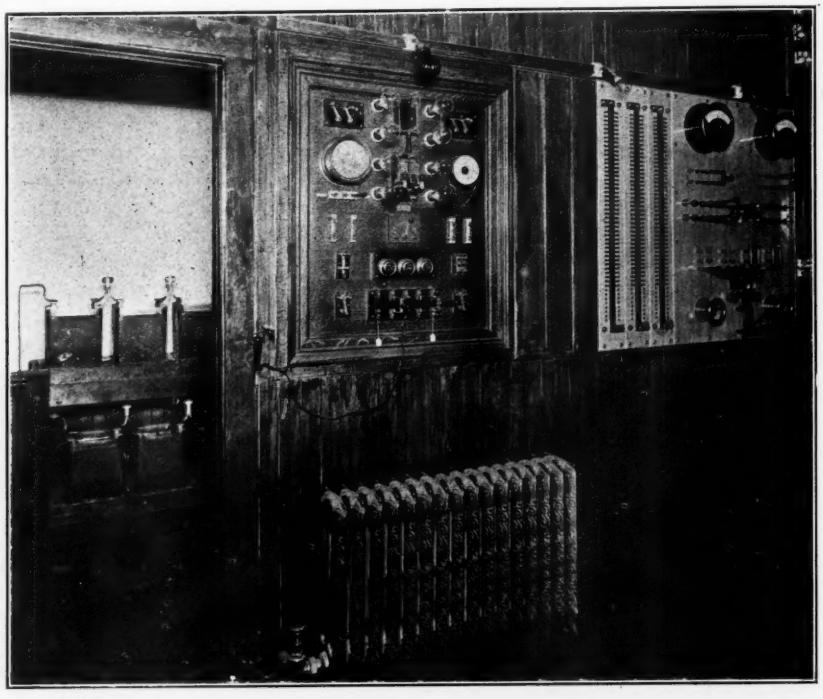
# *The Geneva Telephone Company, Geneva, N. Y.*

ABOUT six years ago the Geneva Automatic Telephone Company was organized and for a number of years successfully operated this system.

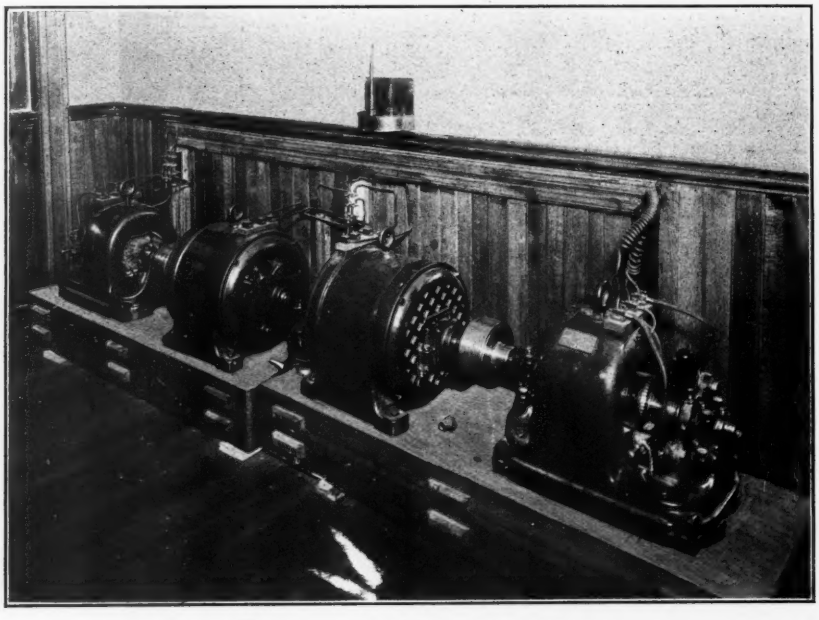
SECTION OF DISTRIBUTING RACK, GENEVA, N. Y., TELEPHONE COMPANY.

In 1902, however, the company was reorganized under the name of the Geneva Telephone Company and the new company decided to install a full common battery system and rebuild the plant.

Work was commenced on this about the middle of September, 1902, and was rapidly pushed to completion. On February 1, 1903, the exchange was opened, giving service to something over 300 patrons. Since February 1 the list of subscribers has more than doubled, being now over 600. By January 1, 1904, the list will reach the 1,000 mark.



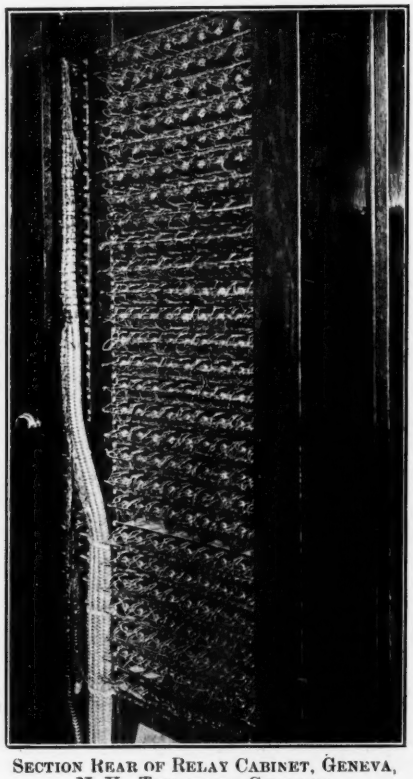
POWER BOARD AND PORTION OF BATTERY ROOM, GENEVA, N. Y., TELEPHONE COMPANY.



CHARGING MACHINES, GENEVA, N. Y., TELEPHONE COMPANY.

On account of Geneva being the home of the nursery business of the country, the loyal citizens spared no expense and trouble to beautify the city by liberally planting shade trees on all the streets and avenues.

Their efforts have been amply rewarded from a picturesque point of view, for Geneva is a beautiful city, but from a telephone engineer's standpoint it presented many a hard problem in the way of "tree trouble." These problems were so successfully overcome by the liberal use of cable and "tree wire" that the outside plant is now one in which the city takes great pride. The cable distribution is such as to readily handle the future growth of the plant.



SECTION REAR OF RELAY CABINET, GENEVA, N. Y., TELEPHONE COMPANY.

The central station or exchange is handsomely furnished and decorated. The switchboard is of the multiple type, with

electric light line and double electric light supervisory signals arranged for party line system. The cabinet is of quartered oak finished in golden oak to match the woodwork of the room.

The arrangement of the multiple jacks is such as to allow a full set of multiple jacks to each two operators' positions.

The present equipment is 600 lines, with an ultimate capacity of 1,600. With the present installation, however, using the rapid party line system, the board can easily handle from 1,200 to 1,500 subscribers.

The outside cables terminate in 100-pair terminal heads, equipped with lightning and high-current protectors. From these heads the cable is conducted through "cable runs" to the cabinet which contains the main and intermediate racks, from which they run to the multiple and answering jacks.

The relay and distributing cabinets are finished to match the switchboard and are equipped with glass doors so arranged as to allow of easy access to both front and back of the relays and racks.

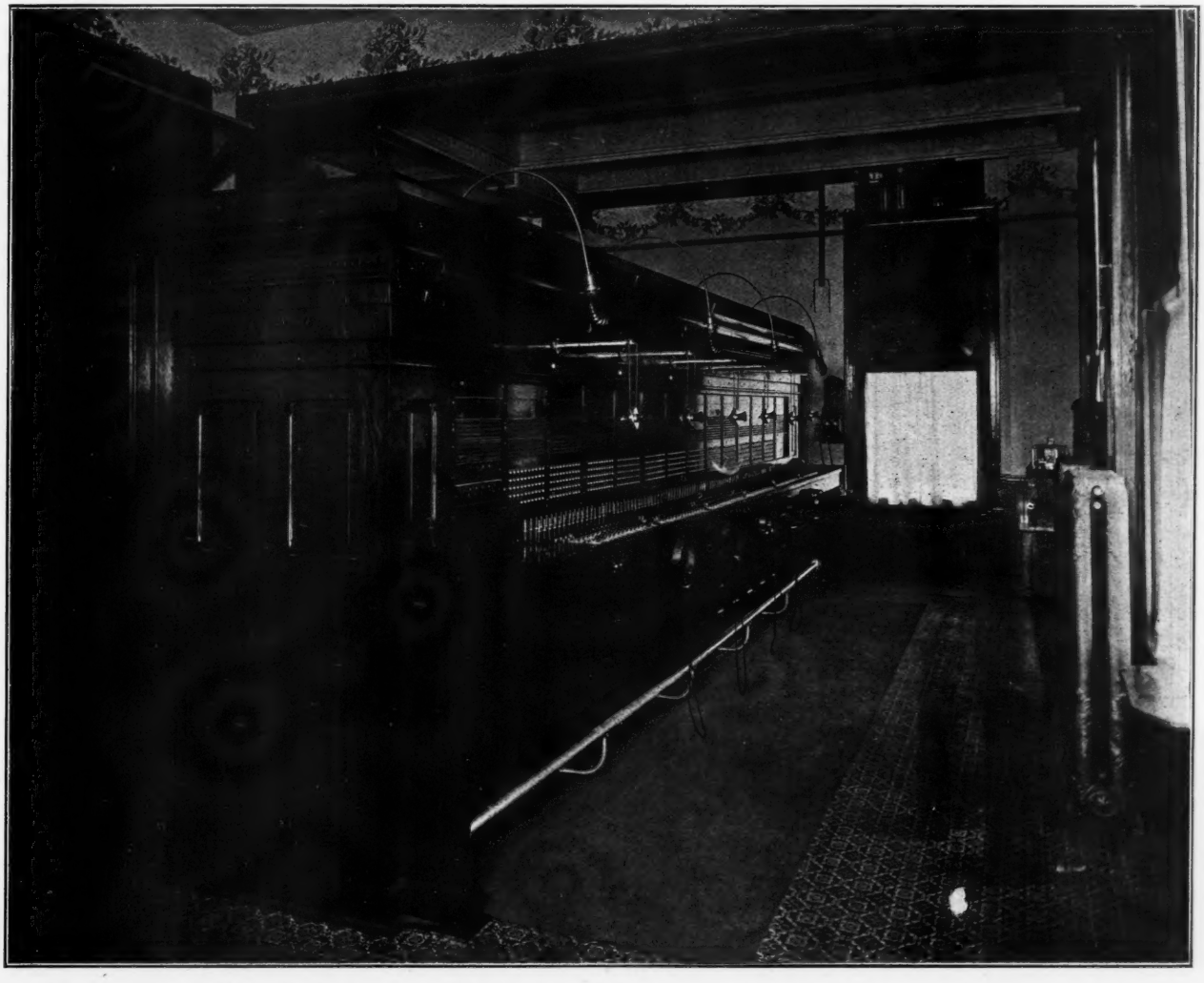
The power plant consists of two sets, twelve each, of chloride accumulator storage batteries of 520 ampere-hour capacity, furnished by the Electric Storage Battery Company, of Philadelphia, Pa.

The motor-dynamos for charging are the alternating-current motor and direct-current generators, manufactured by the Wagner Electric Manufacturing Company, of St. Louis, Mo. The power boards are pink Tennessee marble, on which are mounted the volt and ammeters, switches, etc. The measuring instruments are the round pattern, type F, made by the Weston Electrical Instrument Company, Waverly Park, N. J. The switches are the tubular knife switch type, made by the Crouse-Hinds Company, Syracuse, N. Y. The I-T-E circuit-breakers are furnished by the Cutter Company, Philadelphia, Pa.

The fuse board is also of pink Tennessee marble, on which are mounted the regulation fuses.

The Geneva Telephone Company is under the management of Mr. F. S. Bronson, who takes great pride in his exchange.

The contract for building and equipping the plant was awarded to the Century Telephone Construction Company, of Buffalo, N. Y. This company manufactured all the central station and substation apparatus in its Buffalo factory. This company has built and equipped many similar successful exchanges throughout the western and central part of New York state.

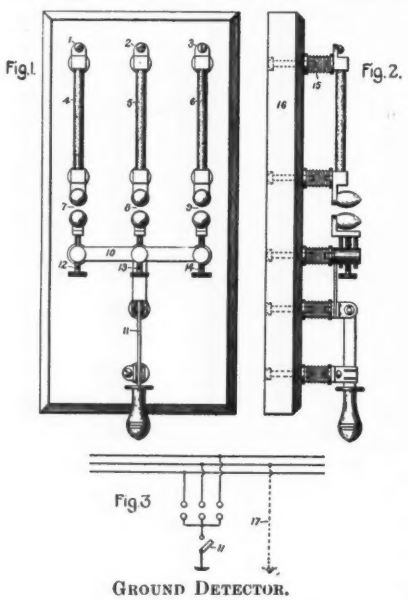


MAIN OPERATING SWITCHBOARD, EXCHANGE OF GENEVA, N. Y., TELEPHONE COMPANY.

Radium salts can be separated into two parts, one small but very active, and the other containing the greater part of the material, but inactive. Upon standing, the active part loses its radioactivity, while the other regains it, and this fact seems to indicate that the same set of molecules can not remain radioactive.

# Electrical Patents.

A ground detector having several novel features has been invented by Mr. Charles C. Badeau, of Schenectady, N. Y., who has assigned his interest to the General Electric Company. The object of this invention is to provide an effective ground detector for electric circuits, and to distinguish between a static and dynamic discharge, by a device durable and simple in construction. The essential feature of the invention consists in providing a spark-gap between the lines and earth at the point at which the detector is located, and means for increasing the length of said gap with respect to a charge between the line wires. The best form thus far devised in carrying out the invention comprises a plurality of gaps with respect to the line wires, the aggregate sparking distance of which the potential of the line is unable to bridge, and a switch for throwing on and off a ground. Thus, if

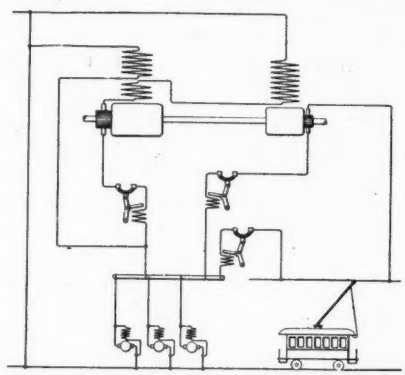



GROUND DETECTOR.

a discharge occurs across the gaps a removal of the ground will force the potential to traverse the aggregate arcing distance, and since the line potential is unable to do this, a dynamic discharge will be quieted, thereby indicating the character of the discharge. Included in series with the device is a resistance for cutting down the current, so as to prevent destruction of the contacts. The invention therefore consists in a ground detector provided with means for requiring a longer path of discharge from wire to wire than from any wire to ground in connection with a switch for throwing off and on the ground, and comprises also a plurality of discharge paths from different line wires in connection with a common ground switch.

In the accompanying illustrations of the invention, Fig. 1 is a front view of an apparatus embodying the improvements. Fig. 2 is a side elevation, and Fig. 3 is a diagram showing the relation of the instrument to a circuit. Referring first to Figs. 1 and 2, 1, 2, 3 represent terminals adapted to be connected with leads from a circuit. The device shown is adapted to three-wire circuits or triphase circuits, though the improvements are in no respect limited to such an application. In series with the terminals are resistance blocks 4, 5, 6, such as a baked mixture of graphite and clay, connected in series relation to spark-gaps 7, 8, 9, mounted in a common metal support 10, adapted for connection with ground through a switch 11. Each gap may be varied in length by means of adjusting screws 12, 13, 14. The parts are supported upon insulating pillars, as 15, mounted upon a base 16. In a three-wire circuit the terminals 1, 2, 3 are connected with the three line wires, respectively, or for a two-wire circuit two may be so connected. The gaps are adjusted with respect to the circuit so that the arcing distance of the several gaps interposed between the line wires will be longer than the potential of the system can jump. The switch is normally closed. Thus, if a ground occurs on the system the line potential is sufficient to spark across but one of the gaps, and by opening the switch the sparking will cease. If, however, the discharge is a static one the sparking will still continue, since the aggregate gap is within jumping distance of a static discharge. The dotted line 17, in Fig. 3, indicates a supposed ground on one of the line wires. The switch 11 being assumed closed, the gap will be abridged, but opening the switch will quiet the discharge if dynamic in character. If, however, the discharge is static, it will still continue. A gap is preferably provided for each wire, since an indication thus is afforded as to the wire on which the ground occurs. The parts being in multiple, the grounded wire will be the only one in whose spark-gap no sparking will occur. The interposition of the resistance blocks 4, 5, 6 cuts down the current, thus preventing damage to the instrument and waste of energy, and at the same time acts as a relief for the line from static charges.

In operating constant-potential systems of electrical distribution it is common to employ electromotive-force devices between the generator and the distributing network to raise the potential on particular wires or feeders in order to compensate for decrease of potential due to excessive load on such wires or feeders. These devices are commonly electrodynamic boosters, which are generally placed in the station to compensate for the drop over a long feeder or from increase of load. These devices are sometimes engine driven and sometimes operated by electric motors. When motor driven, any damage to the motor which destroys its driving power—as, for instance, an opening of the switch controlling the motor circuit, or a throwing of its circuit-breaker, or other accident tending to stop it—leaves the booster without a driving power, and under the current of the feeder circuit it reverses and becomes a motor, and being commonly a series-wound device rapidly accumulates speed until it is torn apart by centrifugal force. A new means for controlling these electric boosters has been patented by Mr. Merle J. Wightman, of New Brighton, N. Y., the patent thereon being assigned to the General Electric Company, of New York. It is the object of the invention to prevent such disastrous consequences, and means



CONTROLLING ELECTRIC BOOSTERS.

are provided for automatically protecting the booster from "running away," as it is called, in case the driving motor ceases to operate. In carrying out the invention, the series field commonly provided for boosters is dispensed with and instead a field winding connected in the circuit of the driving electric motor is employed. By this means if the motor circuit opens, or its armature burns out, or motor current is interrupted in any way, the field magnet becomes deenergized and the booster comes to a stop. In some cases, as where a considerable lead must be given to the brushes to ensure the best operation of the booster, a few opposing turns on the field magnet are provided and connected in the feeder circuit, so as to counteract the tendency to magnetize the field magnet from armature reaction, and even in cases where ordinary lead only is provided a few opposing turns of this kind may be employed in order to destroy effectually the residual magnetism of the field.

### TECHNICAL ASSOCIATIONS AT SARATOGA.

MEETINGS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, THE AMERICAN RAILWAY MASTER MECHANICS AND THE MASTER CAR BUILDERS.

The American Society of Mechanical Engineers held a four-days' session at the United States Hotel, Saratoga Springs, N. Y., last week, beginning Tuesday, July 23. The meeting was very well attended. The society will hold its annual session in New York city, in December of this year.

On Friday the members of the society and their friends were the guests of the General Electric Company and the American Locomotive Company, at Schenectady, a special train taking them over and back. They were very pleasantly entained and shown through the very extensive works of both companies.

The ELECTRICAL REVIEW will publish several of the papers which were read and discussed at this meeting of the society.

The American Railway Master Mechanics' Association concluded its thirty-sixth annual convention at the Grand Union Hotel, Saratoga, Friday, June 26. Many of its members remained over this week to attend the session of the Master Car Builders' Association, which began Monday and continued until Wednesday. Mr. George H. Daniels, general passenger agent of the New York Central & Hudson River Railroad, made a witty opening address, welcoming the car builders to Saratoga.

The Master Mechanics elected the following officers for the ensuing year:

President, W. H. Lewis, of Roanoke; first vice-president, P. H. Peck, of Chicago; second vice-president, H. F. Hall, of Cleveland; third vice-president, J. F. Deems, of New York; treasurer, Angus Sinclair, of New York city; secretary, Joseph W. Taylor, of Chicago.

It seemed to be a very fortunate arrangement that brought together these three technical associations at Saratoga Springs. It proved to be a great advantage in many ways, and there was a constant mingling of the practical and technical men that can not fail to be of much value in advancing the interests of all the associations and of the industries which their membership represent.

Among the attendants at the various meetings were A. A. Thresher, Dayton, Ohio; J. N. Derby, New York; A. L. Rohrer, Schenectady, N. Y.; A. L. Doremus, F. V. Henshaw and Charles W. Startsman, Ampere, N. J.; Colonel John T. Dickinson, New York; J. A. Werner, Philadelphia; Frank G. Bolles, Cincinnati, Ohio; J. C. Shainwald, New York; Edgar Peckham, Kingston, N. Y.; A. B. Prool, Jr., New York; Daniel M. Brady, New York; E. H. Mullin, New York; E. T. Lyle, Buffalo; A. N. Spencer, Cincinnati, Ohio; G. A. Hagar, St. Louis, Mo.; Charles A. Moore, New York; W. M. Probasco, Pittsburg; Ray D. Lillibridge, New York; T. F. Lyman, New York; J. E. Meek, New York; Frederick Swift, Boston, Mass., and A. J. Rosseau, Chicago, Ill.

At the meetings on Thursday, June 25, the report on "Electrically Driven Shops" was presented by C. A. Seley, and was discussed at some length by the author and by R. H. Soule, L. R. Pomeroy, W. R. McKeen, H. H. Vaughan and others.

Among the electrical and allied interests were the following exhibitors and exhibits, to be seen at the Grand Union Hotel:

The H. W. Johns-Manville Company, of New York city, had an exhibit of its products in the south side of the Grand Union court. This company was ably represented by Messrs. W. E. Robinson, T. F. Lyman, J. E. Meek and others.

Manning, Maxwell & Moore, of New York, were represented by Messrs. Charles A. Moore, J. N. Derby, C. E. Randall, D. F. Williston, George E. Terry, F. P. Smith, Percy Brotherhood and others.

The Westinghouse Air Brake Company had a very interesting exhibit, with a beautifully illuminated sign, and was represented by Messrs. Herman Westinghouse, W. M. Probasco, F. M. Nellis, E. M. Herr, E. L. Adrean, S. J. Kidder and others of its staff from Pittsburg and St. Louis.

The Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill., and Rochester, N. Y., had a very excellent exhibit of its various types of telephones and telephone apparatus, and distributed some very handsome new illustrated catalogues. Mr. A. J. Rosseau, of Chicago, was in charge of the exhibit.

The Peckham Manufacturing Company, of Kingston, N. Y., had a large exhibit. A four-ton Peckham electric truck, designed for high-speed electric railways, with a speed of from forty to seventy miles per hour, was shown. E. Peckham and others represented this company.

The Consolidated Railway, Electric Lighting and Equipment Company, of New York, was represented by Colonel John T. Dickinson, and had on exhibition the Pullman car Elysian, equipped throughout with the lighting system of this company. This car, which was used by President Roosevelt in his recent extensive tour, was shown on a side-track of the Delaware & Hudson Railroad, and was visited by a large number of practical railway men.

The General Electric Company was ably represented, among the gentlemen in attendance being A. L. Rohrer, J. R. McKee, E. H. Mullin, H. D. Hawkes and F. H. Gale.

The Robbins Conveying Belt Company, New York city, presented an interesting exhibit, and was represented by A. B. Prool, Jr., E. Williamson Miller, G. Murray and others.

Mr. Frank G. Bolles represented the Bullock Electric Manufacturing Company, of Cincinnati, and distributed some interesting literature respecting the well-known Bullock electrical apparatus.

The Crocker-Wheeler Company, of Ampere, N. J., was strongly represented, and an interesting poster in colors, relating to the product of this company, was to be seen conspicuously in the various hotels. Among the representatives present were A. L. Doremus, Putnam A. Bates, Charles W. Startsman, F. B. Degress and F. V. Henshaw.

The Link Belt Engineering Company, Nicetown, Philadelphia, Pa., was represented by J. A. Werner, R. R. Fauntleroy and J. M. Dodge.

The Standard Paint Company, of New York, was represented by J. C. Shainwald and J. N. Richards.

The Buffalo Forge Company had an interesting exhibit, and was represented by E. T. Lyle and W. F. Wendt.

Mr. A. N. Spencer represented the J. A. Fay & Egan Company, of Cincinnati, Ohio.

The B. F. Goodrich Company, Dayton, Ohio, was represented by Roger Johnson.

Mr. E. G. Fisher represented the National Electric Headlight Company.

Mr. Frederick Swift, president of the Boston Car Wheel Company, 501 Tremont Building, Boston, was in attendance. Mr. Swift is an old electric light man, and is now actively engaged in the car-wheel business. He is also the New England agent for the Baldwin Locomotive Works.

### Copper Production in Hungary.

In Hungary, in 1901, there were mined 161,548 metric tons of copper, the value of which was about $47,313. The quantity produced in the preceding calendar year was some twenty tons greater. Formerly eighty per cent of the copper was mined by the government, but in the past year only fifty per cent was so mined. There are at present sixteen copper-mining concerns in Hungary, of which two state and three private undertakings supply the greater part of the metal.

# Reviews of Current Engineering and Scientific Literature.

### The Pino Hydroscope.

The hydroscope is an instrument for enabling one to examine visually submerged bodies. This particular one is for use in examining the bottoms of vessels. It consists of a telescoping tube, with one or more right-angle bends, in which are placed mirrors. The lower part carries a number of incandescent lamps, which serve to illuminate the object to be examined. A system of wipers, operated by hand, serves to remove all moisture condensing on the glass cover or mirrors. The instrument can be arranged to examine surfaces in a vertical position, or, by the addition of a second bend, the bottom of vessels. The outer surface of the glass end-plate is kept clean by streams of water. Lenses are arranged within the interior to condense the beam of light and transmit it to the eye-piece at the upper end.—*Abstracted from the Electrical Engineer (London), May 29.*

### The Vizzola Electric Power Plant, Italy.

This gives a brief description of the large hydraulic power plant at Vizzola, Italy. In developing this the Societa Lombarda has expended about $2,400,000. The plant supplies energy for factory driving and for lighting neighboring towns. From the central station ten three-phase circuits distribute energy to distances of about twenty-five miles. The total length of the primary lines is eighty-seven miles. On January 1 last, this system was supplying 15,000 incandescent lamps and 750 electric motors from ninety-eight substations. The capacity of the substations is 15,500 kilowatts. In the central station are ten generators of 2,000 horse-power each, each driven directly by a turbine. There are also three sets of exciters, each of 200 horse-power. The waterfall varies from seventy-five to eighty-seven feet, and it is conducted to the turbines by twelve steel tubes six feet in diameter. Three of the alternators generate current at 11,000 volts, fifty cycles. The river Ticino is the source of supply of the water, the total length of the canal that had to be constructed was about four and one-quarter miles with a drop of fifteen per 1,000 and with a capacity of about 1,000,000 gallons per minute. The water velocity was 4.5 feet per second. The average income from the sale of power is $40 per horse-power-year. The generating plant is at present fully loaded throughout the greater part of the day, so that the operating company is now erecting a new plant nine miles further down the river, where a fall of twenty-seven feet is available and 6,000 horse-power can be developed. A steam plant is also being erected at Castallanza, where 5,400 horse-power will be available. This plant will supply power for excessive demands and when the water is low.—*Abstracted from the Electrical Engineer (London), June 12.*

### Measurement of the Efficiency of Asynchronous Motors.

In this article M. Larmoyer discusses two methods of testing induction motors. The first is that due to Heyland, in which the performance of the motor is deduced by the use of the general transformer diagram, and the methods of determining the constants used in this computation are described. The second method is that known as the separation of losses, and is due to Swinburne. In this the no-load losses are measured, the Foucault losses are calculated, and in this way the efficiency of the machine under the load is predetermined. The use of these two methods is illustrated by an example, and the results of the two methods agree satisfactorily. The motor tested was a three-phase induction motor, of thirty-two horse-power, 460 volts, fifty cycles, running at 750 revolutions. The Heyland method gave an efficiency under load of 82.2 per cent. The slip was 2.63 per cent. The Swinburne method gave an efficiency of eighty-eight per cent, and the slip was 2.66 per cent.—*Translated and abstracted from the Bulletin of the Association des Ingénieurs Electriciens (Liege), June 10.*

### A Notable Observation with Radium.

When undertaking some work in the weighing of radium, Herr Ernest Dorn secured about thirty milligrammes of the strongest radium bromide on December 3, 1902. This was contained in a small tube of glass free from alkali. The tube was six millimetres long and 0.46 millimetre in diameter, the glass being 0.3 millimetre thick. The tube was sealed by fusing. On May 27 of this year, after nearly six months, it was decided to open the tube. In order to do this the tube was held in the left hand and a three-corner file was used to cut the glass. As soon as this file scratched the glass, an electric spark punctured the glass, with some noise. The spark was bright enough to be noticed, although the author was standing close to a window on a bright summer afternoon. The noise was heard by a second person, who was standing in the middle of the room. The explanation suggested for this phenomenon, is that the negative electrons had passed through the glass walls and escaped, while the positive electrons had been retained within the tube. This had caused an electric charge to appear on the outside of the tube, assisted possibly by the radium rays. It is noteworthy that the potential was sufficient to break through at least 0.2 millimetre of glass.—*Translated and abstracted from Physikalische Zeitschrift,* June 15.

### Note on the Probable Occasional Instability of All Matter.

In this connection Sir Oliver J. Lodge considers the effect of acceleration of an actively charged electron. An equation is deduced giving the radiating power in terms of the mass of the particle, its acceleration and charge and the velocity of light. In this equation the eighth power of the velocity of the rapidly moving particle appears. Now, as radiation loss is equivalent to a resisting medium, and accordingly the revolving particle tends to move inward toward its centre and its speed to increase. A slight increase in speed brings about a great increase in the radiating power, wherefore the change, once begun, tends to increase until the speed approaches the velocity of light. On the electric theory of matter, radiation or loss of energy must occur from every atom, and therefore it is only a question of time how long an atom shall last before it reaches this stage. Directly this stage is reached another effect supervenes, the rapidly moving portion of the mass begins rapidly to rise in value. This effect is unimportant until the speed comes very near to the light velocity, but the mass becomes suddenly infinite or very great when the light velocity is attained. It would seem that the momentum must increase and must disturb the balance of forces holding the parts of the system together. In an extreme case it might happen that the lighter body would suddenly become the heavier and would jerk the rest of the atom off. In any case it appears likely that an atom

at this stage would begin to break up. In other words, the fact of the electronic radiation seems to carry with it liability to change or decay of all matter possessing an electric constitution, the change from one form to another being accompanied by radioactivity. Attention is directed to a sort of astronomical analogy to this, in the contracting or gradual collapsing of a nebula, with the occasional shrinking off of peripheral material as an unstable stage is periodically reached. The author says further that this critical stage is reached only when the velocity of the moving particle approaches very nearly that of light. When it is within one per cent of the light speed the mass is trebled, and when it is within one part in a thousand of its limiting velocity, the mass is quintupled.—*Abstracted from Nature (London), June* 11.

### *Theory of a Singing Arc.*

It is well known that an alternating-current arc, shunted by a capacity and an inductance, will give a musical note. In this article, M. P. Barry describes an experiment made to test a suggested explanation. The pitch of the note depends upon the capacity and the inductance of the shunt circuits. A rapid oscillation of the current is produced by this circuit, which sets the gas in the arc and the surrounding air into vibration. The author believed that this effect was similar to the breaking up of a stream of mercury or other liquid when highly charged, and in order to test this, a circuit was set up, in which an arc lamp was supplied by means of storage batteries. In shunt with this arc was connected a capacity and an inductance, a system of lenses threw the image of the arc on a screen, passing the beam of light first through a perforated disc. This circuit gave the usual singing note. By revolving the disc in time with this note and by shifting its phase, an image could be secured of any particular phase of the action. By means of this, the variations in the light of the arc could be followed, and it was seen that in one instant the arc was out. The current variations were traced by means of the Blondel oscillograph, which showed that the current varied with a frequency equal to the pitch of the note. If the note was pure, the curve obtained was sinusoidal, but if harmonics were present, it was irregular. In all cases it fell to zero at one instant. The author thinks that the explanation usually given for the breaking up of a stream of conducting liquid when charged, is sufficient to explain this phenomenon, and that the arc starts again after going out because the carbons and the column of gas between them are still hot.—*Translated and abstracted from L'Industrie Electrique, June* 10.

### *The Prevention of Electrically Deposited Dust.*

It has frequently been noticed that where electrical circuits are supplied from the continuous-current system with a voltage above 200, dust gathers in the vicinity of all flexible conductors and on the lamps. Mr. D. S. Munro here considers the probable cause of this phenomenon and suggested a method of preventing it. It seems evident that a number of small particles of suspended matter, in a normal room, are floating in the air approximately at earth potential. These are drawn toward the outer wire, either being positive or negative, and those particles which are not too firmly caught and held in the small hairs of the braiding, are in time charged and projected with force against the wall or whatever happens to be near. The author made an experiment with the object of comparing the effect of differently surrounded conductors. The board was covered with smooth white paper and vertically across this were fixed a number of conductors all of the same resistance. The distance from the wire to the paper was one-half an inch. Part of these wires were connected to the positive side of the circuit and the others to the negative side. These wires were so connected that they remained charged at all times. They included bare copper and vulcanized rubber, silk-covered, flexible wire and Glover wire taped and braided, and a conductor concentrically covered with lead. After eight days the positive bare wire and the external positive concentric were distinctly covered with dust, and the paper behind them held a streak of dust. The silk-covered flexible wire next showed signs and in about fourteen days was thickly covered. At the end of one month, the Glover wire and the paper behind it showed slight signs of dust. In the case of the wires connected to the earth side, there was no indication of dust. In ordinary circuit wires, the comparatively thick dielectric minimizes the collecting property, and there seems to be no way of preventing the collection of dust on high-voltage lamps. It is suggested that if flexible conductors were made concentric with the earth, connected outside, there would be no such trouble.—*Abstracted from the Electrical Review (London), June* 5.

### *Energy Losses on Electric Cars.*

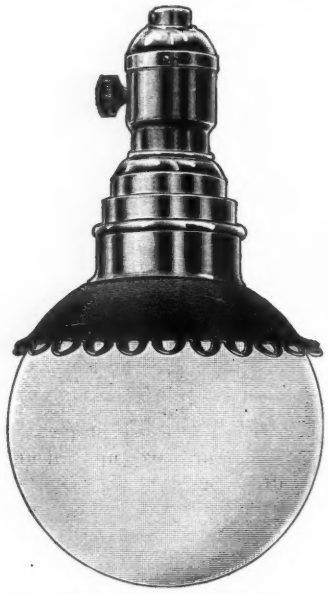
In designing an electric traction system the greatest care is taken to obtain a plant that will generate and distribute the necessary power at the least expense, but after this has been delivered to the car very little attention is paid to its economical use. Mr. W. Park here discusses this phase of electric car operation, and shows how the expense of running the car might be materially reduced. A good deal may be accomplished by a proper training of the motorman and an insistance upon a correct handling of the car. In cases where recording wattmeters have been installed the records of power consumed vary as much as twenty or thirty per cent on similar cars operating under similar conditions. But aside from this phase of the problem a considerable saving may be effected by increasing the running time of the cars somewhat. As an illustration two cases are cited: The car is assumed to weigh twenty-eight tons. The length of the run is one-half a mile in each case. In the first case this distance is covered in 108 seconds, and in the second case in 136 seconds, the schedule speed, allowing twenty seconds for stops, being fourteen miles per hour in the first case, and eleven and one-half miles in the second case. The entire distance is covered without a stop. In the first case the energy consumption is sixty-one watt-hours per ton-mile, and in the second case forty-five watt-hours per ton-mile. The overall efficiency in the first case is forty-nine per cent, and in the second case, sixty-two per cent. The difference in the running is brought about by accelerating the car for fifty-five seconds in the first case, and then allowing it to drift for thirty-five seconds, and bringing it to a stop with the brakes in eighteen seconds. In the second case the car is accelerated for thirty-five seconds only, so that the maximum speed is but twenty-one miles per hour, as against twenty-three with the other. It then drifts for ninety-five seconds, and is brought to a standstill in six seconds. The energy saved in the second case is lost in braking where the highest speed is obtained, but is made with a sacrifice of twenty-eight seconds' time. Another point urged by the author is the saving effected by decreasing the number of stops. It would be possible not only to decrease the power consumed, but also to reduce considerably the running time, by appointing fixed stopping-places and adhering strictly to these.—*Abstracted from the Tramway and Railway World (London), June* 11.

# INDUSTRIAL SECTION.

*ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.*

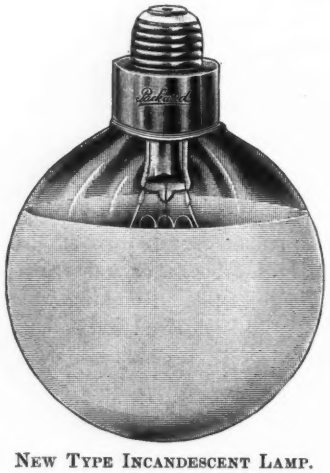
## *New Type Incandescent Lamp.*

The Electric Appliance Company, Chicago, Ill., is placing on the market the "Zenith" incandescent lamp, manufactured by Packard. The "Zenith" lamp is



NEW TYPE INCANDESCENT LAMP.

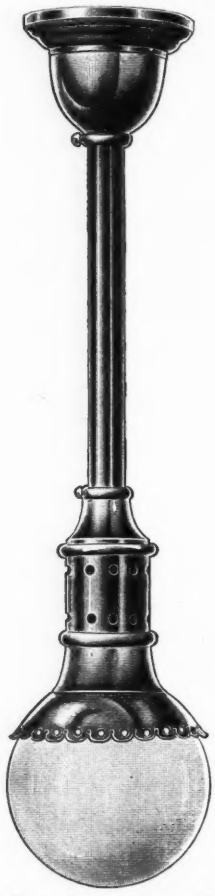
claimed to be an intermediate between the arc lamp and the incandescent lamp, retaining the simplicity of the latter. It is made in two sizes, twenty-five and fifty-five candle-power, at two efficiencies, 1.9 and 2.18. This new type of incandescent lamp gives a brilliant yet soft white light,



NEW TYPE INCANDESCENT LAMP.

which is evenly distributed beneath the lamp. The range of voltage is from 90 to 150, and the lamp is furnished regular with Edison base, but can be furnished also with T.-H. base. The manufacturer claims that the lamp possesses simplicity, reliability, high efficiency and low first cost, and that it can be used on either alternating or direct-current circuits, and requires no attention during life.

The simple collar (style A) adapts this lamp for use on any style of fixture, or



NEW TYPE INCANDESCENT LAMP.

it is furnished complete with ceiling stem. The accompanying illustrations give a good idea of several forms of this lamp.

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The new marine barracks at the Naval Academy, Annapolis, are to be lighted by electricity, generated by a motor-generator set consisting of a 100-horse-power direct-current motor mounted on the same bed-plate with and direct-connected to a sixty-kilowatt, two-phase alternator. The current will be generated at 1,100 volts and transmitted across the river and there transformed to 440 volts. These machines have recently been ordered from the Westinghouse Electric and Manufacturing Company, together with the usual switchboard and auxiliary apparatus.

## *Gold Car Heating and Lighting Company.*

The amount of heating apparatus sold by the Gold Car Heating and Lighting Company during the past year was nearly double that of any former year since the origin of this business. Not only has the tremendous increase taken place in its steam railway car heating department, but the electric heating branch has developed and improved very materially as well. During the past three months, the number of cars and locomotives for which orders for heating equipment has been received has been very gratifying. A few of the orders recently taken by the Gold company for car, locomotive and electric car heating equipment are as follows:

| | Equipments. |
|---|---|
| Canadian Pacific | 290 |
| Brooklyn Heights Railroad | 240 |
| Missouri Pacific | 125 |
| Wabash | 105 |
| Erie | 102 |
| New York, New Haven & Hartford | 101 |
| Massachusetts Electric Companies | 100 |
| Metropolitan Street Railway | 100 |
| Southern | 79 |
| Louisville Railway | 75 |
| Central Railroad Company of New Jersey | 58 |
| New York Central & Hudson River Railroad | 45 |
| New Orleans & North Eastern | 40 |
| Boston & Albany | 37 |
| C. C. C. & St. L. | 36 |
| Denver & Rio Grande | 35 |
| Chicago & Eastern Illinois | 32 |
| Western Maryland | 21 |
| South Side Elevated | 20 |
| Scranton Railway | 15 |
| Nashville, Chattanooga & St. Louis | 21 |
| M. St. P. & S. S. M. | 22 |
| Cincinnati, Hamilton & Dayton | 12 |
| Texas & Pacific | 24 |
| Georgia Railroad | 4 |
| Lake Shore & Michigan Southern | 15 |
| Boston & Maine | 28 |
| New York, Ontario & Western | 14 |
| Delaware, Lackawanna & Western | 25 |
| Chesapeake & Ohio | 5 |
| Atlanta & West Point | 6 |
| Central of Georgia | 14 |
| Alabama Great Southern | 4 |
| Cincinnati, New Orleans & Texas Pacific | 14 |
| Vicksburg, Shreveport & Pacific | 8 |
| Alabama & Vicksburg | 6 |
| Mobile & Ohio | 15 |
| Louisville & Nashville | 3 |

Within the last few months the company has sold nearly 4,000 sets of its heating equipment in the United States alone. During the past month an order has also been received for the shipment of several thousand sets of its specialties abroad.

The very general adoption of its car, locomotive and electric heating apparatus all over the world, where modern appliances of this kind are used, speaks volumes for the merit of the improved Gold system of car heating.

The main office of Gold Car Heating and Lighting Company is at Frankfort and Cliff streets, New York city. The other offices of the company are at Chicago and London.

### *Alternating-Current Series Arc Lamps.*

In developing the series alternating-current enclosed system, types of which apparatus are shown in the accompanying illustrations, the Adams-Bagnall Electric Company, of Cleveland, Ohio, has aimed to produce a line of great simplicity and reliability in operation, low in cost of maintenance, and possessing at the same time the highest economy and sensitiveness of action.

Fig. 3 shows the regulator used with this system. The essential parts of this regulator consist of an M-shaped iron element and a movable coil, partly counterbalanced by a weight working over a knife-edge bearing. The coil is wound in sections to avoid excessive voltage between adjacent parts, and is constructed so as to run at a low temperature. This is important to the life of the coil, as well as economy in operation.

Oil dashpots are provided, which ensure steadiness in operation and enable the circuit to be started by simply closing the line switch. In operation, the weight is placed so as to balance that part of the weight of the coil not lifted by magnetism. It will be readily seen that this arrangement gives a minimum inertia of moving parts. When operating a full circuit of lamps, the movement of the regulator coil is very slight, requiring only weak dashpot adjustment, and rendering the regulation very sensitive.

FIG. 1.—ALTERNATING-CURRENT SERIES ARC LAMP.

Figs. 1 and 2 show the type of lamp, and, in outward appearance, the shunt and differential lamps are identical. The cases are of pure Lake copper, stamped to shape. The outer globe is spherical, with a single opening, giving a neat appearance and maximum strength. Stamped steel enameled reflectors are used in connection with inner and outer globes for all outside work. The inner globe is pear-shaped, open at one end only, giving a maximum life of carbon.

The controlling apparatus is of simple construction, and is especially designed for easy trimming in any kind of weather. A door opening in the side of the case renders the mechanism instantly available for inspection. The lamp parts are largely interchangeable. Special attention is given to securing insulation of a non-combustible nature.

FIG. 2.—ALTERNATING-CURRENT SERIES ARC LAMP.

An electromagnetic mechanism, instead of solenoid control, is used for the mechanical operation of the lamp. The electromagnets being very sensitive, the manufacturer states that this gives an absolute uniformity of range, the anti-friction construction making it possible to maintain a constant voltage at all times.

The alternating-current differential lamp consists essentially of a flexible lever rocking over a knife edge, carrying at its opposite ends a shunt and series electromagnet, to the former of which is attached the clutch mechanism. By the peculiar shaping of the pole tips of these electromagnets a uniform range in voltage is obtained, from the point of pick-up to that of feeding. The electromagnetic control enables the operation of the lamp with a low energy consumption. Coin silver contacts are used for the cutouts, and a small Krupp resistance is used for starting the lamp after it is properly trimmed.

In the shunt lamp of this type a safety circuit, closed by a small balance lever, is employed, which automatically operates to throw the coarse wire spool into action to bring the carbons together. In a lamp tested for seventy volts this circuit closes at eighty volts, so that the shunt winding never has to meet an electromotive force greater than eighty volts. As the small lever has no winding, it in no way complicates the lamp. Either set of the main cutout contacts is ample to carry the full current continuously, but a second set is only for additional safety, and closes by the same movement that controls the first set.

The operation of the shunt lamp of this type is as follows: Nominally, the shunt circuit is the only path across the lamp. As soon as the current is turned on, however, and the pressure across the lamp rises to eighty volts, a small auxiliary cutout is brought into play, and closes a safety circuit through the main cutout winding. The cutout spool now attracts its armature, and moves upward until the carbons drop together. The carbon path, having the lowest resistance of any, takes practically all of the current when the cutout spool overbalances the shunt spool, and the auxiliary contacts fall apart. The cutout spool continues to fall, separating the carbons until the pull of the shunt balances the weight of the cutout spool. If, for any reason, the carbons do not come together, the cutout spool continues in an upward motion until the main cutout contacts make up, after which the lamp stands cutout until the circuit is shut off.

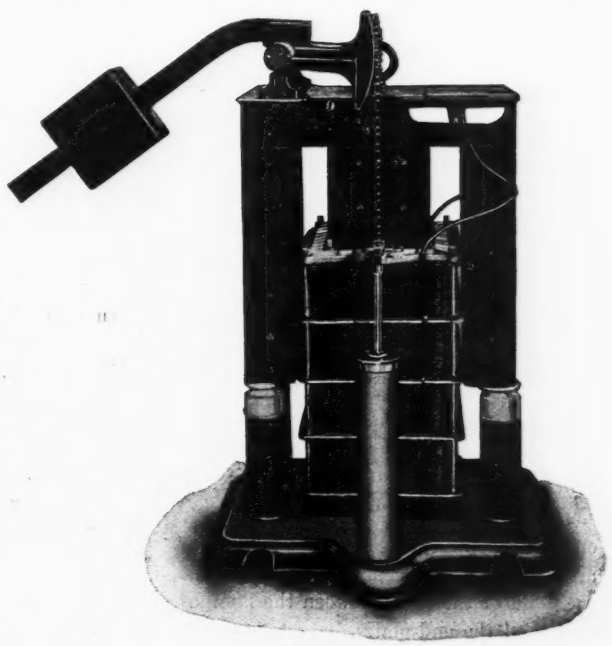


FIG. 3.—REGULATOR.

### *Engine-Type Railway Generators.*

The accompanying illustrations show several stages of the assembly of the engine-type railway generators which the Stanley Electric Manufacturing Company, of Pittsfield, Mass., has designed to fulfill the extraordinary conditions which a continuous-current generator must meet in railway service. Fig. 1 shows the armature of a ten-pole railway generator; Fig. 2, the armature ventilating device, and Fig. 3, the field of a ten-pole railway generator. Fig. 4 shows a "S. K. C." railway generator direct-connected to a cross-compound Corliss engine.

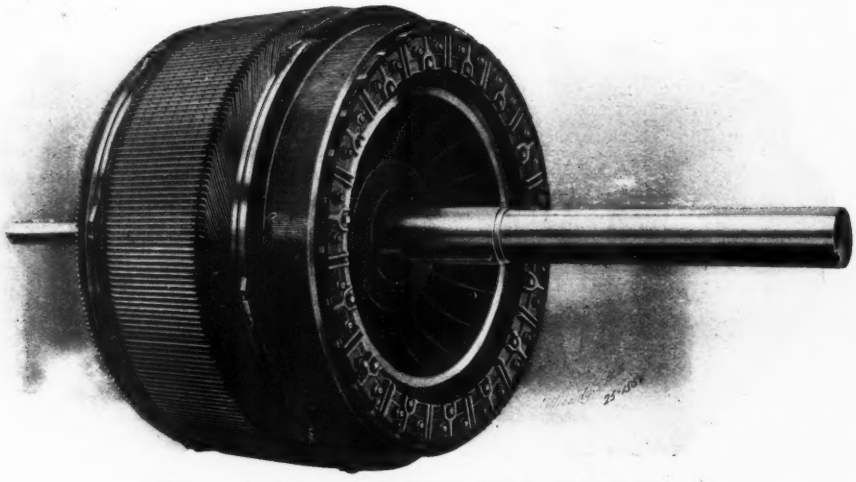


FIG. 1.—ARMATURE OF TEN-POLE RAILWAY GENERATOR.

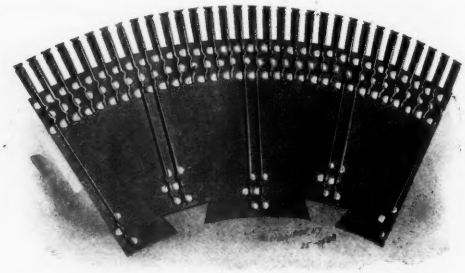


FIG. 2.—ARMATURE VENTILATING DEVICE.

The armature laminations are dovetailed into the arms of a cast-iron spider, and are clamped between two end-rings drawn together by bolts passing inside of the laminations, cast in one piece with the end-rings on the supports for the armature winding. The laminations are subdivided by ventilating ducts of novel construction. The steel fingers are held between supports bent up from punchings in the manner shown in Fig. 2, and the space thus left entirely open for the free circulation of air. Ventilating ducts are also placed at each end of the core, between the laminations and the end-plates.

The armature is all in the same cylindrical surface, and, with but few exceptions, is of the multiple or parallel type. Equalizing rings are placed on the ends of the core, and are connected to the winding at proper intervals. These rings equalize any difference or potential under the different poles, due to any slight mechanical or electrical lack of symmetry. The coils are formed and insulated before being placed in the slots, and are held in place by wedges in the slots and by bands over the ends.

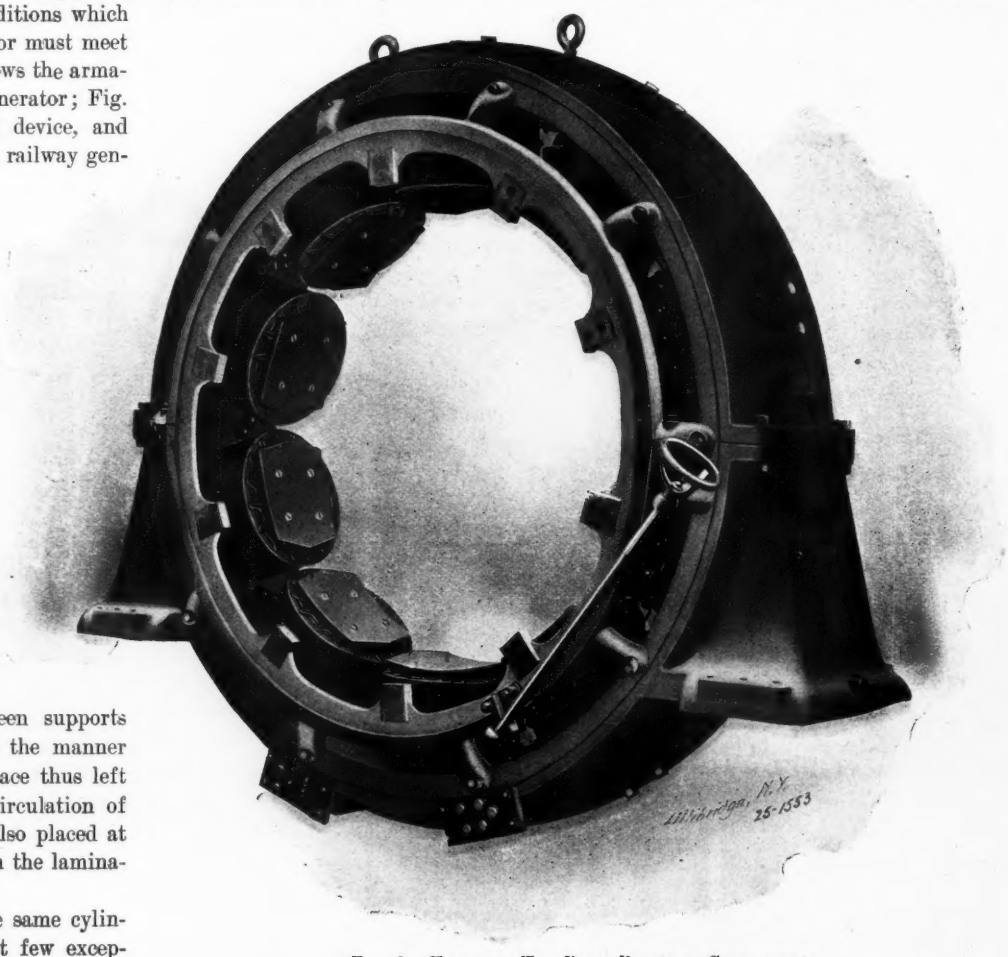


FIG. 3.—FIELD OF TEN-POLE RAILWAY GENERATOR

The commutator is built upon a separate spider which is mounted upon a projection of that of the armature. The clamping rings are held together by bolts which pass completely through the spider. The end-ring is in sections, so that one part may be removed without dismantling the whole commutator.

The field yoke is made of cast iron, and is parted horizontally. The inside of the ring is turned out smooth, and where the steel poles fit against the yoke the pole is extended. The pole is made of cast steel; and the pole-shoes of cast iron. The pole is bolted through the yoke with two bolts, and the shoe is held against the pole core by screws through its face.

The poles are of rectangular section, with rounded ends. The field coil is round, allowing a ventilating space on each side of the pole core. The shunt and

series windings are wound separately, and are kept apart and from the poles by fibre strips.

The manufacturer states that the greatest advance made in these machines is in their electrical design. The idea of subdivision of all reactions has been carried out in every part. The temperature rise of any part, after a continuous run at full load for twenty-four hours, will not exceed thirty-five per cent. The machine will carry twenty-five per cent overload continuously with a rise not exceeding fifty degrees centigrade, and will carry fifty per cent overload for two hours with a rise not exceeding fifty-five degrees centigrade. The length of iron between two ventilating ducts has been made unusually short, and the cross-connections of the armature coils are well exposed to the air.

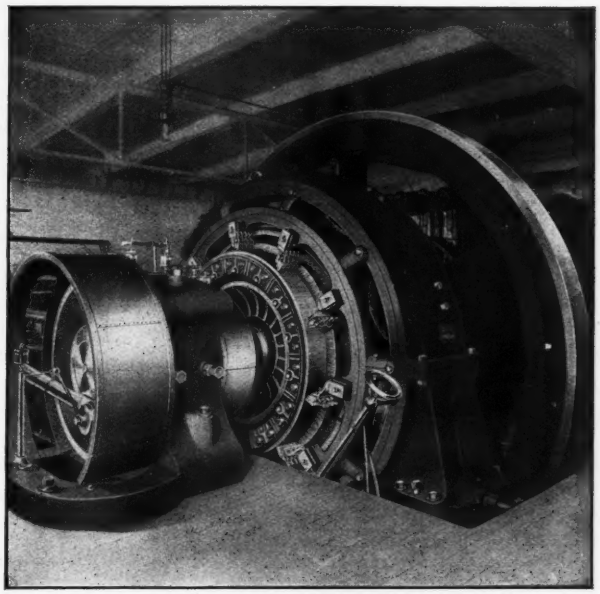


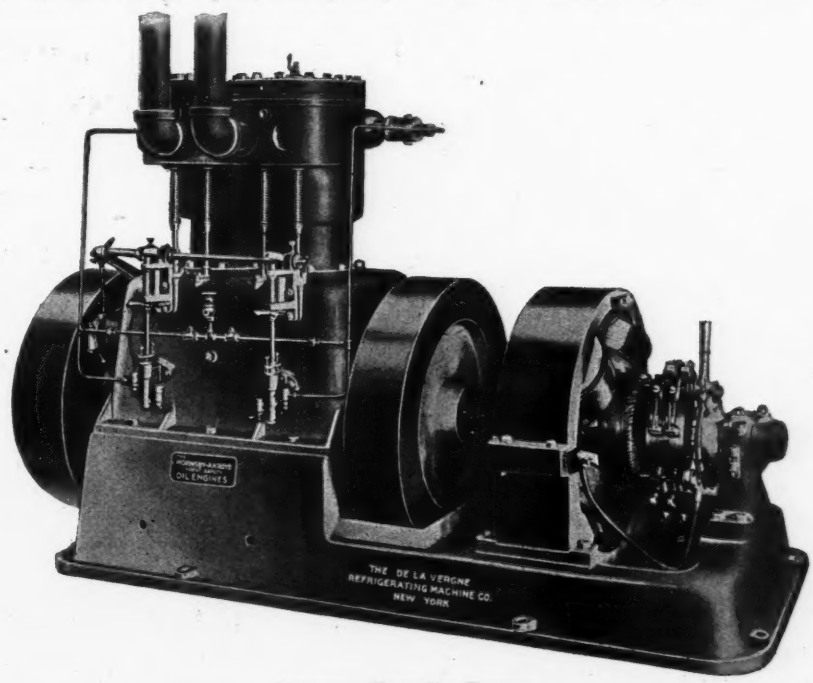
FIG. 4.—RAILWAY GENERATOR DIRECT-CONNECTED TO CROSS-COMPOUND CORLISS ENGINE.

### *The "Hornsby-Akroyd" Oil Engine, Vertical Type.*

The "Hornsby-Akroyd" oil engine of the horizontal type is being very largely used for operating dynamos for electric lighting and power work. This engine has hitherto been chiefly made of the horizontal type, and, operating at a comparatively slow speed, is suitable only for operating the dynamo by belting.

In order to satisfy the demand which has arisen for direct-connected outfits the maker of this engine, the De La Vergne Refrigerating Machine Company, New York city, has recently put on the market a vertical type two-cylinder oil or kerosene engine which is shown in the accompanying illustration. The engine here shown is of fifteen horse-power and runs at a speed of about 450 revolutions per minute. Other sizes are in preparation. The crank-shaft of the engine is rigidly connected to the dynamo by shaft coupling. The crank-pins are set in line and an explosion each revolution of the crank-shaft is obtained. The engine operates on the four-cycle plan, consequently proper combustion is obtained in the cylinder. The fuel is supplied to the vaporizers by two separate oil supply pumps, accordingly the engine can be operated as a single-cylinder engine should it be desired to do so. The regulating speed governor, the most important feature of direct-connected outfit, is the Rites patent governor placed in the flywheel of the engine. The regulation of speed is effected by automatically varying the length of the oil pump stroke. Thus if the load on the engine is decreased the governor, by means of an eccentric, suitably decreases the stroke of the oil pump, varying exactly the pressure in the cylinder to suit the load which the engine has to overcome. Perfect regulation of speed is guaranteed by the maker and it claims variation in speed of less than two per cent. The incandescent lights obtained being absolutely steady, no matter how rapidly the load is changed within the limits of the power of the engine.

The consumption of oil, it is stated, is less than one pound per actual horse-power-hour, the fuel used being ordinary kerosene, crude or fuel oil. When using kerosene the cost of operation is approximately one cent per horse-power-hour. When crude oil is used this cost is usually less than one-half cent per horse-power-hour. The operation of this engine is entirely automatic and it requires no adjustment whatever, the only attention necessary being the heating up of the vaporizers for five or ten minutes before starting and occasional lubrication afterward.




VERTICAL TYPE OIL ENGINE.

For the purpose of furnishing current to the arc lamps at the Allouez ore docks on Lake Superior, which are the largest iron ore docks in the world, the Great Northern Railway Company has recently purchased from the Westinghouse Electric and Manufacturing Company two seventy-five-kilowatt, 2,200-volt, two-phase generators, complete with two 5.62-kilowatt exciters, and a four-panel switchboard. The order also calls for seven seven and one-half and one two and one-half kilowatt transformers.

### *The Convention Group.*

The accompanying illustration is a group of the delegates and attendants at the seventh annual convention of the Independent Telephone Association of the United States of America. The two-days' session at the Auditorium Hotel, Chicago, June 24 and 25, was not as well attended as in some former years, but those who were there found a pleasant reception and thoroughly enjoyed meeting with old friends and making new acquaintances. The committees worked arduously to properly entertain those who had made the trip and were present at Chicago. Many faces of old-time telephone men, pioneers in the industry, will be recognized in this group, and as the retiring of Judge Thomas from the presidency was the signal for a thorough getting together of kindred spirits, this group will be preserved with more than ordinary interest.

A Group of Delegates and Attendants at the Convention of the Independent Telephone Association of the United States, Chicago, June 24 and 25.

### *Steam Turbine and Electrical Power Machinery for Philadelphia Subway.*

One of the largest contracts for steam turbines and electric power machinery recorded in American territory has been closed by Westinghouse, Church, Kerr & Company with the Philadelphia Rapid Transit Company, covering 15,000 kilowatts of steam turbine and approximately 50,000 kilowatts of electrical generating and converting machinery, for equipping the new rapid transit subway and elevated system now under construction in Philadelphia. The most interesting feature of the equipment to be installed, is that steam turbines are to be used exclusively for power generation in the new central station, now under construction. There will be three turbines installed, each of 5,000 kilowatts normal capacity, which will be of the type now being built by the Westinghouse Machine Company for large powers. The turbines will be direct-connected to Westinghouse three-phase, twenty-five-cycle generators, and the units will run at 750 revolutions per minute with 175 pounds of steam, twenty-seven and one-half inches vacuum and possibly 100 to 150 degrees of superheat. The three units will operate in multiple upon a common bus-bar, and power will be distributed directly at a nominal potential of 13,000 volts from the station without the use of any intermediate transformers; for this purpose the generators are wound for high potential.

The new power station will be located upon the Delaware River, near the foot of Green street, and is laid out for an ultimate capacity of 50,000 kilowatts, it being the idea of its designers to concentrate at this point the entire power generating equipment at present distributed among a number of smaller stations. The location of the new station upon the river bank secures excellent coaling facilities and an inexhaustible supply of water for condensing purposes.

The present equipment will furnish power for the subway and some reserve power for the surface traction system pending the execution of proposed plans for centralizing the entire power system.

The contract also comprises a large amount of transforming and converting machinery to be installed in the several substations, which will be built at various locations in the district covered by the transit system. This machinery will be used for converting the high-tension alternating-current power received from the power station into low-potential direct current for use directly upon the third rail of the traction system. The first installation will comprise fourteen 1,000-kilowatt and two 500-kilowatt rotary converters. Each of the 100-kilowatt rotaries will be furnished with three 375-kilowatt step-down transformers and each of the 500-kilowatt rotaries with three 175-kilowatt transformers of similar design. The electrical equipment will be built by the Westinghouse Electric and Manufacturing Company.

The new rapid transit system, now under construction, will cover the entire business district of Philadelphia, and includes a two and four-track subway about one and one-quarter miles in length, extending from the Delaware River along Market street, to a point near Twenty-third street, a short distance from the Schuylkill River. At Broad street an appropriate central terminal station will be erected. The enterprise is one of the most important in the history of American railway development, and the introduction of the steam turbine in such large sizes is particularly gratifying by reason of the confidence shown in this comparatively new type of prime mover.

### *The Manchester Section of the British Institution of Electrical Engineers.*

The third annual report of the Manchester section of the British Institution of Electrical Engineers has been received. Owing to the absence of the chairman, Mr. H. A. Earle, in South Africa, it was impossible for him to deliver his opening address until the opening of the second half of the session, Mr. Edward W. Cowan occupying the chair.

Nine ordinary general meetings were held, at which papers were read. These meetings were all well attended, there being an average of 118 members and visitors present. The membership of the association stands as follows: 75 members, 127 associate members, 188 associates and 82 students, making a total of 472, or forty-seven more than last year. The meetings of the section were held in the new physical laboratory of Owens College, and the committee expresses its appreciation of the kindness of the council and Dr. Schuster.

# CURRENT ELECTRICAL NEWS

### *DOMESTIC AND EXPORT.*

LONG-DISTANCE OHIO RAILROAD—A contract for grading and covering the route between Napoleon and Defiance, Ohio, has been awarded by the People's Rapid Transit Railway Company to Morrison, Fowler & Scott. It is stated that cars will be running between Toledo and Defiance by next fall. The plan is to build north from Cincinnati, and south from Toledo. Originally, the southern terminus was at Greenville, Darke County, 150 miles distant. Then the project was enlarged and the route extended to Cincinnati. The section now building from Toledo to Defiance is fifty miles in length. The project, complete, contemplates a road 220 miles long, and will pass through fifty-four cities and towns. The company will carry express goods, freight and passengers. The franchise privileges include freight cartage. The directory of the company was reorganized after the route was extended from Greenville south, and now includes the following gentlemen: J. Morgan, president and general manager; W. P. Heston, Adam Burger, L. J. Weadock, T. M. Franey and M. A. Merkley, of Toledo; G. Bloodhart, Gibsonburg; Charles F. Clay, Napoleon; J. C. Diehl, Defiance; O. K. Dickinson, Paulding; J. H. Pulskamp, Selina; T. J. Hostetter, Ansonia; W. H. Pennell, Van Wirt, and H. H. Farr, Eaton.

NEW YORK CENTRAL TO BEGIN WORK SHORTLY—The preliminary work for the building of the new terminal of the New York Central Railroad Company will be started within the month, according to the latest announcement. The first task will be to tear down the buildings on the area between Forty-fifth and Forty-seventh streets and Lexington and Park avenues. The old sewer, gas and water mains will have to be taken up, and the building of new ones to take their places will be accomplished. Bids will be called for at once, and the contract will include rock and earth moving, masonry, laying tracks and erecting the steel work. An entirely new temporary terminal will be built at Forty-fifth street and Lexington avenue. At this temporary terminal all the local traffic will be handled, only the through trains running down to the present terminal. There can not be much work done under the existing tracks, as the locomotives and cars used in daily service are too heavy to warrant methods similar to that which is successful in ordinary subway work. Two large power stations will be built, one north of the Harlem River, and the other still further away. The exact locations of these are not yet talked about. In the switching service it may be necessary to use an overhead trolley service, but it will be different from that ordinarily installed. Generally speaking, the electric power will be transmitted by the third rail. This rail will be covered and protected so that rain, snow or sleet can not, by any possibility, interfere with the moving of traffic. It is stated that the work will be in full swing by September 1. The Board of Estimate and Apportionment has considered the revised plans for the terminal improvements, and after being presented, one by one, these were all formally approved.

### *PERSONAL MENTION.*

MR. JOHN RICE, sales manager of the Standard Electrical Manufacturing Company, Niles, Ohio, was a New York visitor for several days of last week.

MR. CHARLES E. BROWN, secretary of the Central Electric Company, and Mr. W. W. Low, president of the Electric Appliance Company, were among the Chicago visitors to New York last week.

MR. JOSEPH HYDE PRATT, of the Engineering Company of America, is making an extended trip through the West, looking over properties for which the Engineering Company acts in the capacity of consulting engineer.

MR. A. R. BLISS, of Lowell, Mass., is making an extended visit to a number of western and southern states, in the interests of his company, the New England Motor Company, of which he is the treasurer and general manager.

MR. CYRUS O. BAKER, JR., president of the firm of Baker & Company, platinum refiners, of Newark, N. J., sailed on Wednesday of last week on the Philadelphia for Europe, where he will make a stay of two months visiting European capitals, including London, Berlin, Paris and St. Petersburg.

MR. AND MRS. T. F. MANVILLE and family sailed on the Kaiser Wilhelm II., on June 23, for London and the Continent, where they will spend the next two months. Mr. Manville goes to London on business in connection with the London branch of the H. W. Johns-Manville Company.

MR. C. H. MORTIMER, secretary-treasurer of the Canadian Electrical Association, is a prominent figure in Dominion electrical circles. Mr. Mortimer is proprietor and editor of the Canadian *Electrical News*. At the recent convention at Toronto, miniature daily editions were distributed to all in attendance.

MR. FRANK G. BOLLES, manager of sales of the Bullock Electric Manufacturing Company, Cincinnati, Ohio, passed through New York city last week on his way to the Saratoga convention of the Master Mechanics, the Mechanical Engineers and the Master Car Builders, and proceeded to Niagara Falls, where he was a prominent figure at the convention of the American Institute of Electrical Engineers.

MR. H. M. LITTELL has accepted the general managership of the Rapid Transit Company, of Chattanooga, Tenn., and left for his new field of work this week. Mr. Littell is an experienced and able railway manager, an ex-president of the American Street Railway Association, and will be sure to win additional honors now that, after a rest of a few years, he has decided to actively enter again upon street railway management.

MR. CHARLES DAY, Philadelphia, Pa., at the meeting of the American Society of Mechanical Engineers, held at Saratoga, presented a paper entitled "The Machine Shop Problem." Mr. Day has been more than singularly successful in handling this problem, delineating in a graphical manner the essence of the best modern practice in machine shop development. The discussion which followed Mr. Day's paper was interesting and conclusive, and of a highly complimentary nature to the author.

MR. L. W. STANTON, consulting and constructing telephone engineer, of Cleveland, Ohio, is working on a number of new installations. Mr. Stanton is making a specialty of multiple cable distribution and construction. Mr. F. A. Focke has resigned his position as engineer for the Federal Telephone Company, and accepted an appointment with Mr. Stanton, and Mr. C. E. Kent, also well-known and for some time prominently connected with large telephone interests, is also now identified with Mr. Stanton in his work.

MR. A. E. MEIXELL, formerly the superintendent of the Fairmount Park Transportation Company, Philadelphia, has accepted a connection with H. F. Sanville, 710 Girard Trust Building, Philadelphia, and in future will represent Mr. Sanville throughout the state of Pennsylvania. Mr. Sanville is a dealer in street railway supplies and his office acts as a Philadelphia sales department for the following companies: Albert & J. M. Anderson Manufacturing Company, Waclark Wire Company, Electric Railway Equipment Company, Simonds' Manufacturing Company, and Johnson Wrecking Frog Company.

MR. M. H. GERRY, JR., chief engineer and general manager of the Missouri River Power Company, was unavoidably absent from the meeting of the Montana Society of Engineers, before which body he was to read a paper on the 50,000-volt transmission plant and system of this company. The paper was read by the secretary, after which details of the plant were fully explained by Mr. W. L. Miller, the resident representative of the company in Butte. The various phases of this and other electric power transmission systems were discussed by Messrs. Hebgen, Sickles, Magnus, Traphagen and others.

### ELECTRIC LIGHTING.

FONDA, IOWA—An electric light plant will be installed in this village.

MADISON, MINN.—This city will double the capacity of its electric plant, at a cost of $8,000.

MANKATO, MINN.—At a mass meeting of the citizens it was decided to install an electric light plant.

MIDDLETOWN, N. Y.—The Haverstraw electric light plant has been sold to S. R. Bradley, of Nyack, for $21,000.

WARRENSBURG, N. Y.—Thomas J. Smith, of this village, will establish an electric light plant at North Creek.

SCHALENBURG, TEX.—C. L. Melcher has purchased the electric light plant from L. E. Mueller, of Houston.

STOCKTON, CAL.—The electors of Stockton have voted to bond the municipality for $160,000 and build a lighting plant.

GRAND RAPIDS, N. D.—Ralph Maxwell has been granted an exclusive electric light franchise for the city of Lidgerwood.

KINGSTON, N. Y.—The board of directors of Saugerties has granted a franchise to the Ulster Heat, Light and Power Company.

WINONA, MINN.—The Winona Railway and Light Company has been granted a ten-year contract by the city to light its streets.

BEAUMONT, TEX.—A deal has been completed whereby the electric light plant has changed hands. The consideration was $275,000.

BURLINGTON, VT.—At a special meeting of the city council it was voted to establish a municipal electric lighting plant, to cost $150,000.

HARRODSBURG, KY.—The city has commenced work on the new electric light plant here, and it will probably be ready for operation by September 1.

GUTHRIE CENTER, IOWA—The $15,000 required to build the new electric lighting plant has all been subscribed, and a site has been purchased. Work will begin at once.

MUNCIE, IND.—The central power-house of the Union Traction Company, at Anderson, is being enlarged, so that the power for 275 miles of electric lines will be generated there.

HUNTSVILLE, ALA.—The city council has ratified the contract with the Huntsville Railway, Light and Power Company. The company will light the city for five years, at the rate of $75 per light per annum.

AUGUSTA, ME.—The name of the Clinton Electrical Company has been changed to the Primary Power Company. The company has voted to decrease its capital from $2,000,000 to $1,000,000, and the par value from $100 to $50.

ALBANY, N. Y.—The residents of Menands and Brookside have formed a company for the purpose of lighting their houses with electricity. The company is capitalized at $10,000, and the plant will be in operation before the winter sets in.

WATERLOO, ILL.—The Secretary of State has granted a license to incorporate to the Taylorsville Gas and Electric Company, with a capital stock of $85,000. The company is organized for the purpose of consolidating the business of the Citizens' Gas Company and the Taylorsville Electric Company.

DENVER, COL.—A mortgage for $1,000,000 was issued recently in the county clerk's office on the property of the Denver Gas and Electric Company. The instrument is made out to the Bankers' Trust Company, of New York city. The mortgage secures an issue of one thousand $1,000 bonds, to run for fifteen years with interest at six per cent.

BOYNE CITY, MICH.—E. A. Stowe and C. C. Follmer, of Grand Rapids, are at the head of an enterprise which will utilize the power of Boyne River for the purpose of supplying electric light and power to this city. The plant, it is said, will cost about $20,000, and it is expected that it will be completed and in operation by October 1. About 200 horse-power will be developed.

SAN FRANCISCO, CAL.—The Kaweah River Power Company has been incorporated for the purpose of generating electric power on the Kaweah River, and distributing it to mines, etc., in the vicinity. Its capital stock is $2,500,000, and its directors are Edward Records, of San Francisco; Leon M. Hall, Edward W. McGrath and Albert W. Havens, of Oakland, and William G. Morrow, of Sausalito.

BALTIC, CT.—The Scotland Electric Company, with a capital of $100,000, has been chartered. The incorporators are John Eccles, Frederick Sayles and Harold Lawton. The company has plans for the development of large water privileges on the Shetucket River in the towns of Canterbury and Scotland. It is authorized to distribute electricity in Windham County and also in the towns of Franklin, Sprague and Lisbon.

NORTH ADAMS, MASS.—It is said that plans are being perfected for the development of a great electrical power plant to utilize the water power from Howe's Pond in Readsboro, Vt., and from the Deerfield River, most of the power from which will be brought to this city. Boston and Providence capitalists are behind the scheme, and a company will probably be formed shortly with a capital of at least $300,000.

SAN FRANCISCO, CAL.—It is stated that an eastern company of influential men, with G. M. Broyles, of French Corral, as their representative and also one of their number, has taken up a water right on the Middle Yuba River, in Sierra County, near Smartsville. The company will incorporate and ere long begin the construction of a large power plant on the site. It is expected that not less than 25,000 horse-power can be developed.

### ELECTRIC RAILWAYS.

PHILADELPHIA, PA.—A charter has been issued to the Central Pennsylvania Traction Company, which will take over the Harrisburg Traction Company and subsidiary lines. The capital stock is $2,100,000.

OKLAHOMA CITY, OKLA.—The Oklahoma Traction Company has let the contract for the construction of an electric railway from this city to Guthrie, a distance of thirty-five miles. The road will cost $300,000. Work has begun.

COATESVILLE, PA.—A charter has been granted to the Brandywine Electric Street Railway Company, with a capital of $600,000, to build a trolley line from Coatesville to Parkesburg and Downington. The company is composed of Coatesville capitalists.

DANBURY, CT.—The Danbury & Harlem Traction Company, which has partially built an interstate railroad from this place to Goldens Bridge, N. Y., has been authorized by the New York State Railroad Commissioners to issue a mortgage for $500,000 to pay for construction work.

DAYTON, OHIO—The Greenville, Union City and Traction lines have been consolidated, and will be known as the Dayton & Muncie Traction Line. The articles of incorporation, with a capital of $800,000, have been filed. The projectors of the enterprise hope to have the line in running order by November 1.

PHILADELPHIA, PA.—All street railways in and about the towns of West Chester, Coatesville and Downington, in Chester County, have been combined. The combined roads will cover all the northern part of Chester County with nearly fifty miles of track, and will have a capital of more than $500,000.

PLATTSBURG, N. Y.—A deal has been closed between the owners of the Keeseville, Ausable Chasm & Lake Champlain Railroad and a syndicate represented by John P. Powers of Lansingburg, N. Y., for the purchase of the road at a price said to be $60,000. The plan is to convert it into a third-rail electric road. It is said that an electric road will be running to Lake Placid inside of a year.

MONROE, MICH.—A company composed of Ohio and Michigan capitalists has been incorporated for the construction of an electric line between Toledo and Ann Arbor. The company is known as the Ohio & Michigan Traction Company, with a capital of $1,650,000. The power-house is to be located at Petersburg, Mich., and the general offices at Toledo. It is hoped to have the road in operation as far as Dundee, Mich., before the winter. The line will be about forty-five miles in length, *via* Petersburg, Dundee and Milan.

## ELECTRICAL SECURITIES.

A daily study of stock market conditions for the past week could only result in the summing up of a conclusion that, for dulness and general apathy, the conditions are almost record-making. A peculiar undertone prevailed, however, in that the sluggishness was very generally regarded with complacence and, in fact, welcomed by a large portion of the institutions doing business in this manner. Compared with the closing quotations of a week ago, while there have been changes of several points in some instances, the average shows a really better tone. The general conditions, as reported from industrial centres throughout the country, render it impossible for even the most pessimistic to foresee any industrial collapse; and the very gradual decline and easy falling off in prices have made it impossible to figure out any speculative collapse. Within the next two weeks a great many financial institutions and manufacturing concerns will have balanced their semi-annual accounts, and with the breaking in of a new financial period, there seems to be reason to believe that a generally stronger tone will prevail in all quarters.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JUNE 27.

| *New York:* | *Closing.* |
|---|---|
| Brooklyn Rapid Transit | 56 |
| Consolidated Gas | 191¾ |
| General Electric | 179 |
| Kings County Electric | 200 |
| Manhattan Elevated | 136¼ |
| Metropolitan Street Railway | 124 |
| New York & New Jersey Telephone | 161 |
| Westinghouse Manufacturing Company | 198 |

The board of directors of the New York & New Jersey Telephone Company has been increased by the election of the following: Frederick P. Fish, John W. Griggs, Theodore F. Miller, General James Jourdan, William C. Courtney and Waldron Hopkins. The increase in the board was recently authorized by the stockholders. The directors have declared the usual quarterly dividend of 1½ per cent.

| *Boston:* | *Closing.* |
|---|---|
| American Telephone and Telegraph | 140½ |
| Edison Electric Illuminating | 236 |
| Massachusetts Electric | 82 |
| New England Telephone | 128½ |
| Western Telephone & Telegraph preferred | 89 |

The directors of the American Telephone and Telegraph Company have voted to issue $21,943,200 new stock. Holders of record on June 30 will be entitled to subscribe to the new issue on the basis of one share of new stock for every five shares now held. Payments for the new securities are to be made in five installments—$20 per share on September 22 and November 21, 1903; January 22 and March 22, 1904, and the final payment on May 6, 1904, when the new shares will be issued. The company has declared the regular quarterly dividend of 1½ per cent and ¾ per cent extra, payable July 15. Transfer books close July 1 to July 15, inclusive.

| *Philadelphia:* | *Closing.* |
|---|---|
| Electric Company of America | 8½ |
| Electric Storage Battery common | 60 |
| Electric Storage Battery preferred | 60 |
| Philadelphia Electric | 6¼ |
| Union Traction | 44½ |
| United Gas Improvement | 88 |

| *Chicago:* | *Closing.* |
|---|---|
| Chicago Telephone | 125 |
| Chicago Edison Light | 148 |
| Metropolitan Elevated preferred | 66 |
| National Carbon common | 22 |
| National Carbon preferred | 91 |
| Union Traction common | 3½ |
| Union Traction preferred | 30 |

## LEGAL NOTE.

INTERFERENCE PROCEEDINGS DECISION AND APPEAL—The interference proceedings of Spaulding *vs.* Norden were decided by Judge Fitts, of Washington, D. C., in favor of Norden. This refers to the "Norbitt" temporary decorative socket, as made under Mortimer Norden's patents by the Crouse-Hinds Electric Company, of Syracuse, N. Y. Mr. Russell Spaulding, president of the Elblight Company of America, is appealing from this decision.

## TELEPHONE AND TELEGRAPH.

MANHEIM, PA.—The United Telephone Company will establish an exchange in this village.

FLUSHING, OHIO—Work has been commenced on a new telephone line between New Athens and Uniontown.

ST. LOUIS, MO.—The Kinloch Telephone Company has increased its capital stock from $2,000,000 to $3,000,000.

HUNTINGTON, IND.—The Home Telephone Company has been incorporated, and will build lines in Huntington County.

IRVINGTON, N. J.—The New York & New Jersey Telephone Company has been granted a franchise by the town council.

ROME, N. Y.—The common council of this city has voted to grant a telephone franchise to J. Alexander Vanliew, of Albany.

UTICA, N. Y.—The Rensselaer Telephone Company has extended its lines to Albany, Schenectady, Cohoes and Waterford.

CHARLESTON, W. VA.—The Newark Telephone Company, of Newark, Ohio, has been authorized to increase its capital stock from $60,000 to $100,000.

FARMER, N. Y.—The Home Telephone Company will extend its line from Seneca Falls to Ovid, having secured the right of way for its poles and wires.

WALTON, N. Y.—The stockholders of the Riverside Telephone Company, whose line runs from Bainbridge to Sidney, have voted to extend the line to Otsego.

FULTON, N. Y.—The Postal Telegraph Company has set new poles from Ogdensburg to this city, for a new trunk line of six wires between Ogdensburg and Syracuse.

HARRISBURG, PA.—The South Penn Telephone and Telegraph Company, with a capital of $200,000, has been incorporated, the main office of the company being at Waynesburg.

BANGOR, ME.—The State Belt Telephone Company will establish an exchange at Bath, and also extend its line from Bath to Chapman Quarries, Cross Roads and Klecknersville.

TROY, N. Y.—The Clifton Park Telephone Company, of Jonesville, was incorporated recently with a capital of $5,000. The directors include Erastus R. Forte, John R. McElroy and Robert Jump.

DALLAS, TEX.—The independent local and long-distance telephone companies, of Chickasha, I. Ter., have been purchased by the Topeka & El Reno Telephone Company, the consideration being $15,000.

COHOES, N. Y.—It is stated that the independent telephone companies of central New York are to be joined together by a large trunk line system of telephone wires stretching from Erie, Pa., to Rutland, Vt.

EDWARDSVILLE, ILL.—The Kinloch Telephone Company has completed arrangements with the Macoupin County Telephone Company, of Carlinsville, for the construction of a telephone line from Alton to Springfield.

CLEVELAND, OHIO—The United States Telephone Company will increase its capital stock from $2,000,000 to $2,500,000, the additional amount being six per cent preferred stock. The proceeds will pay off the floating debt.

OTTUMWA, IOWA—A new building, to cost between $20,000 and $25,000, will be erected in this city by the Iowa Telephone Company, the work to be commenced at an early date. The entire system will be reorganized and between $80,000 and $100,000 expended.

CANAJOHARIE, N. Y.—The Cooperstown, Cherry Valley & Sharon Springs Telephone Company has been incorporated to operate from Cooperstown to Sharon Springs. The capital is $5,000, and the directors are: A. B. Cox, of Cherry Valley, and D. M. Tickler and Howard Clark, of Cooperstown.

BAKERSFIELD, CAL.—The Southern Pacific is making a number of improvements to its telegraph lines. A new wire has been strung between Los Angeles and Vincente, a distance of sixty miles; another through the mountains, between Bealville and Tehachapi, all of which will be continued to Bakersfield. Lines are also being strung to the north, between Bakersfield, Fresno, Lathrop, Stockton and Sacramento, as well as to Alcalde, Hanford, Portersville and Santa Barbara.

## INDUSTRIAL ITEMS.

THE ROBERTS MANUFACTURERS' AGENCY, Memphis, Tenn., a recently organized company, will act as manufacturers' agent for mechanical and electrical equipments.

THE THOMAS E. CLARK WIRELESS TELEGRAPH-TELEPHONE COMPANY, Detroit, Mich., will be pleased to send its wireless bulletins, comprising Nos. 6 and 7, describing "Junior" type and "Standard No. 1" type instruments, to any one making a request for them.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, New York city, has issued a series of pamphlets descriptive of numerous electrical specialties. This company carries a large stock of all forms of electrical appliances, and a large clerical force ensures prompt deliveries and good service.

THE SWEDISH-AMERICAN TELEPHONE COMPANY, 88-92 West Jackson Boulevard, Chicago, Ill., has just issued an attractive pamphlet entitled, "For They Themselves Have Said It." This company's reputation for high-class advertising is well borne out by this recent publication, and the company will be pleased to send it to interested parties upon request.

THE B-R ELECTRIC AND TELEPHONE MANUFACTURING COMPANY, Kansas City, Mo., is the new company which has been formed as the successor to the B-R Electric Company and the Kansas City Telephone Manufacturing Company. The company has constructed a new building at the corner of Fifth and Delaware streets, and is now established in new quarters.

THE ROPE FIBRE PULLEY COVERING COMPANY, Springfield, Ohio, manufactures a unique covering adapted for pulleys used in transmission service, which covering is claimed to greatly increase the efficiency and lessen the friction for transmission work. The product is inexpensive, and large users of power are finding it a permanent method of reducing power expense.

THE WILLARD STORAGE BATTERY COMPANY, Cleveland, Ohio, has secured an order from the Wilmington City Electric Company for elements to enlarge its battery from 2,000 ampere-hours to 3,400 ampere-hours. The original battery has been in use for five years without renewals. During this time it has carried a load every day. It was on account of this excellent performance that the order for the enlargement of the cells was given.

THE THRESHER ELECTRIC COMPANY, of Dayton, Ohio, has taken possession of its new factories in that city, and will now have about 60,000 square feet of floor space. The new establishment is thoroughly equipped with overhead cranes and the latest tools. These improvements will enable the Thresher company to increase its line of manufacture to units of 1,000 kilowatts. The number of employés will be increased, and the growing business of this well managed company will be promptly taken care of. Mr. A. A. Thresher, who is at the head of the company, is to be congratulated over the success he has won.

THE COMMERCIAL ELECTRIC COMPANY, Indianapolis, Ind., has had occasion to enlarge its quarters for the manufacture of its standard apparatus. The company is now completely installed in a new plant at Twenty-first street and Northwestern avenue. A full equipment of modern shop tools, which will enable it better than ever to maintain its excellent deliveries and keep the standard of its product at a high point, has been installed. The present plant has a capacity of fully four times that of the previous one, but the rapid increase in orders has made it necessary to make further extensions as soon as possible.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, Ill., and Rochester, N. Y., has recently sold to the Kearney Telephone Company, of Kearney, Mo., a 100-drop switchboard and 200 telephones. The telephone and telegraph department of the Southern Pacific Railroad will equip its division from El Paso to New Orleans with this company's apparatus. Mr. A. S. Foote, general foreman of this department, is stringing copper circuits between cities, and from stations to sections underground circuits are used. It is intended to make very general use of the telephone in the railroad service.

THE BRISTOL COMPANY, Waterbury, Ct., has just issued catalogues No. 9 and No. 10, descriptive, respectively, of Bristol's recording pressure and vacuum gauges and Bristol's recording volt, ampere and wattmeters. These catalogues are handsomely illustrated, and each illustration is supplemented by an accurate description of the apparatus. These catalogues contain complete lists of the recorders recently added to an already large list of this class of instruments which the Bristol Company has manufactured so satisfactorily for a long time. Interested parties may secure these catalogues by corresponding with the company.

THE PITTSBURGH TRANSFORMER COMPANY, Pittsburg, Pa., is in receipt of a letter from the Atlantic Coast Electric Light Company, regarding the operation of Pittsburgh transformers on this company's system. Mr. John F. Kellers, the superintendent, states that during one severe lightning storm in the early part of last August, twenty-three transformers of other makes were destroyed, while the Pittsburgh transformers remained uninjured. During the past five years this company has not burned out a single Pittsburgh transformer, nor has any of them caused the slightest trouble. Mr. A. H. Mustard is the sales agent for the Pittsburgh Transformer Company, with offices at 120 Liberty street, New York city.

MESSRS. BAKER & COMPANY, Newark, N. J., platinum refiners, have just issued several highly attractive pamphlets which bear directly upon the platinum refining industry. These are entitled, respectively, "The Alchemistic Symbols," being a brief account of their origin and meaning, by James Lewis Howe, Washington and Lee University; "Platinum," describing the sources of supply, indentification and separation of the ore; "Tucker's Combustion Apparatus for Determining with Accuracy the Volatile Ingredients and Total Ash of Any Organic Matter;" "Shimer's Combustion Apparatus for the Determination of Carbon in Iron, Steel, Etc." Baker & Company are the sole manufacturers of and licensees for these apparatus.

THE TOWER-BINFORD ELECTRIC AND MANUFACTURING COMPANY, Richmond, Va., describes and illustrates a very complete line of electrical apparatus in its catalogue No. 3. This company makes a specialty of knife switches, radial switches, switch boards, panel-boards, fuse blocks, etc. The company has just put a special article on the market which is designated as the "Regina" knife switch. These are single-break, single-throw, fuseless switches, and are made for fifteen and twenty-five amperes capacity, 125 and 250 volts. The fifteen-ampere size is adapted for panel-board work, and is mounted with either turned wood or spade handles. The blades, jaws and current-carrying parts are made of high-grade drawn copper, and the company claims that the switches are perfect in both electrical and mechanical design.

THE GOULD STORAGE BATTERY COMPANY, 25 West Thirty-third street, New York city, has issued a new bulletin descriptive of line batteries. This company has recently closed a number of contracts, among which may be noted those for the following installations: Berlin Street Railway Company, Berlin, N. H., a floating battery of 220 cells; San Jose Street Railway Company, San Jose, Cal., 255 cells, with a twenty-two-kilowatt regulating booster, this contract being obtained through the Western Electrical Supply Company; Newton & Boston Lines, Boston, Mass., removing a battery which formerly floated at the station out to Lexington, Mass., adding to the present plant cells in 617 tanks, and also adding an automatic regulating booster of its constant electromotive-force type with a capacity of fifty kilowatts; St. Louis Smelting and Refining Company, St. Louis, Mo., duplicating a plant which this company had at its factory at Desloge, Mo., by installing 250 cells, changing the plates so that there will be two batteries of eleven plates in nineteen plate tanks. Each of these batteries will be equipped with a double fifteen-kilowatt booster.

## OBITUARY NOTICE.

MAJOR JAMES B. POND, the well-known lecture bureau manager and former newspaper man and author, died at his residence in Jersey City on Sunday, June 21. Major Pond was the most prominent man in his profession of lecture manager, and at the time of his death possessed a very wide acquaintance in all parts of the world. He was the author of "Eccentricities of Genius" and other works, and was an able and interesting writer. At one time or another he was the manager of nearly every distinguished person who lectured for the public, and with scarcely an exception, all of them became his devoted friends. His death will be greatly felt by a multitude of friends. A widow and one son survive him.